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OPERATIONAL TRAJECTORY DATA REPORT

September 10, 1968



AS-205/CSM-101 LAUNCH VEHICLE
OPERATIONAL TRAJECTORY, REVISION I

By

Gordon W. Solmon

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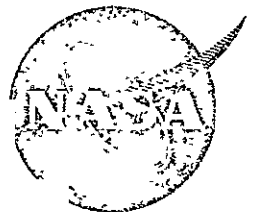
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SPECIAL PROJECTS SECTION
FLIGHT MECHANICS BRANCH
FLIGHT TEST ANALYSIS DIVISION
AERO-ASTRODYNAMICS LABORATORY



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION



GEORGE C. MARSHALL SPACE FLIGHT CENTER

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AS-205/CSM-101 LAUNCH VEHICLE OPERATIONAL TRAJECTORY, REVISION 1

By

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AS-205/CSM-101 LAUNCH VEHICLE OPERATIONAL TRAJECTORY, REVISION 1

By

Gordon W. Solmon

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Huntsville, Alabama

ABSTRACT

This report presents the launch vehicle operational trajectory for the AS-205/CSM-101 mission. Included is a discussion of the predicted trajectory, mission objectives and constraints, and a tracking summary.

The S-IVB/CSM will be placed into a 120 x 150 nautical mile elliptical orbit and will aid in further verification of the launch vehicle and spacecraft subsystems.

NASA - GEORGE C. MARSHALL SPACE FLIGHT CENTER

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DEFINITIONS AND SYMBOLS

Aerodynamic Heating Indicator (AHI)	$\int \frac{q V_r}{\pi/2 - \alpha_t } dt$ <div style="display: flex; justify-content: flex-end; margin-top: -40px;"> <div style="margin-right: 20px;">q = dynamic pressure</div> <div style="margin-right: 20px;">V_r = relative velocity</div> <div>α_t = total angle of attack</div> </div>
Altitude (ALT)	Vehicle altitude above the referenced ellipsoid measured along the geocentric position vector.
Angle of Attack, Pitch (ALP)	Angle between the pitch plane relative velocity component and the longitudinal axis of the vehicle measured positive nose up.
Central Range Angle (RANGLE)	Angle between the instantaneous space fixed position vector and the space fixed position vector at Guidance Release.
Descending Node Argument	Angle measured in the equatorial plane between the orbit plane descending node and the space fixed meridian plane defined at Guidance Reference Release.
Drag	Component of the resultant aerodynamic force along the relative velocity vector, measured positive opposite to the velocity vector.
Dynamic Pressure (QQQ)	$\frac{1}{2} \times (\text{Density}) \times (\text{Relative Velocity})^2$
Earth Fixed Position (XE, YE, ZE)	Position vector components in an earth-fixed pad-centered plumbline coordinate system. The XE axis is coincident with the reference ellipsoid normal, positive upward. The ZE axis is parallel to the earth-fixed aiming azimuth and is positive downrange. The YE axis completes a right-handed system. (PASCS 10)
Earth Fixed Flight Path Angle (VTHE)	Angle between the earth fixed velocity vector and the earth fixed geocentric position vector (PASCS 11), measured positive downrange from the position vector.
Earth Fixed Crossrange	YE component of the earth fixed position. (PACS 10)

DEFINITIONS AND SYMBOLS (Cont'd)

Earth Fixed Velocity Components (DXE, DYE, DZE)	Velocity vector components in PASCs 10.
Earth Fixed Velocity Magnitude (VVVE)	$\sqrt{DXE^2 + DYE^2 + DZE^2}$
Space Fixed Flight Azimuth (AZ*)	Angle between the instantaneous space fixed velocity vector direction and true north, measured positive east of north.
Earth Fixed Flight Azimuth (AZI)	Angle between the instantaneous earth fixed velocity vector direction and true north, measured positive east of north.
Geocentric Declination (DECL)	Angle between the geocentric radius vector and the true equatorial plane measured positive north of the equator.
Geodetic Latitude (LATT)	Angle between the reference ellipsoid normal through the point of interest and the true equatorial plane, measured positive north of the equator.
Ground Range (RANGE)	Surface range measured from the launch site to the sub vehicle point.
Inclination	Angle between the instantaneous flight plane and the equatorial plane.
Longitude (LONG)	Angle between the Greenwich meridian plane and the projection of the geocentric position vector in the equatorial plane, measured positive east of Greenwich.
Longitudinal Acceleration (DDYM)	That part of the total measurable acceleration directed along the longitudinal axis of the vehicle.
Mach Number (MACH)	(Relative Velocity) \div (Local speed of sound)

DEFINITIONS AND SYMBOLS (cont'd)

Thrust	Vehicle thrust .
Mass	Mass of the vehicle.
Pitch, Yaw, Roll (PHIP, PHIY, PHIR)	Eulerian angle of vehicle attitude measured with respect to the space fixed coordinate system. Vehicle attitude is defined by the ordered rotation of pitch, yaw, and roll respectively. PHIP = negative nose downrange; PHIY = positive nose right; PHIR = positive clockwise looking aft.
Pitch, Yaw, Roll Rates (DPHIP, DPHIY, DPHIR)	Vehicle attitude rates.
Radius (RRR)	$\sqrt{X^2 + Y^2 + Z^2}$
Relative Velocity (VR)	Velocity relative to the atmosphere (includes wind velocity).
Space Fixed Position (X, Y, Z)	Position vector components in a space fixed, earth centered, plumbline coordinate system defined at Guidance Reference Release. The X axis is parallel to the reference ellipsoid normal which passes through the launch site. The Z axis is parallel to and positive in the same direction as the earth fixed firing azimuth. The Y axis completes the right handed system. This is Project Apollo Standard Coordinate System 13. (PASCS 13)
Space Fixed Flight Path Angle (VTH*)	Angle between the space-fixed velocity vector and the radius vector (PASCS 13), measured positive downrange from the radius vector.
Space Fixed Velocity Components (DX, DY, DZ)	Velocity vector in PASCS 13.
Space Fixed Velocity Magnitude (VVV*)	$\sqrt{DX^2 + DY^2 + DZ^2}$
Tim	Instantaneous flight time referenced to first motion.
Command Attitudes (CHIP, CHIY, CHIR)	Programmed vehicle attitude commands.

DEFINITIONS AND SYMBOLS (Cont'd)

IU	-	Instrument Unit
SLA	-	Spacecraft Lunar Module Adapter
SM	-	Service Module
CM	-	Command Module
CSM	-	Command Service Module
LES	-	Launch Escape System
PU	-	Propellant Utilization System
APS	-	Auxiliary Propulsion System
IGM	-	Iterative Guidance Mode
GRR	-	Guidance Reference Release
IECO	-	Inboard Engine Cutoff
OECO	-	Outboard Engine Cutoff
PMR	-	Programmed Mixture Ratio
GCS	-	Guidance Cutoff Signal

SUMMARY

This report documents the AS-205/CSM-101 Launch Vehicle Operational Trajectory, Revision 1, data. These data are presented from Guidance Reference Release (GRR) through S-IVB/IU lifetime. All detailed trajectory data are generated using an unbiased S-IB stage tilt program. The revision is necessary because of the decision to have an open loop propellant utilization system in the S-IVB stage.

The predicted S-IB and S-IVB stage end conditions are summarized below:

		<u>S-IB/S-IVB Separation</u>	<u>Guidance Cutoff Signal</u>
Flight Time	(sec)	144.49	614.63
Altitude	(km)	62.00	227.94
Space Fixed Velocity	(m/sec)	2325.8	7780.7
Space Fixed Path Angle	(deg)	63.420	90.007
Range	(km)	61.95	1819.97

The nominal weight at Guidance Cutoff Signal is predicted to be 67757 pounds. This is 1452 pounds in excess of the nominal propellant depletion weight.

The supporting tracking analysis will be published by R-AERO-FT. Summaries of the tracking coverage are presented in Figures 17 - 19.

Summaries of the $\pm 3 \sigma$ trajectory flight envelopes at S-IB/S-IVB separation and S-IVB cutoff are presented in Tables 13 and 14. Detailed dispersion data will be presented in the "AS-205/CSM-101 Launch Vehicle Dispersion Analysis, Revision 1."

SECTION I. INTRODUCTION

The AS-205/CSM-101 Launch Vehicle Operational Trajectory, Revision 1, is presented in this document. Detailed trajectory data are presented from Guidance Reference Release (GRR) through S-IVB/IU lifetime.

Other pertinent data such as tracking and dispersion summaries are also included.

Acknowledgments are made to personnel of R-AERO-FT for providing the tracking data and to Mr. William R. Bailey for the dispersion summaries.

SECTION II. MISSION DESCRIPTION

A. Mission Objectives:

The basic purpose of the AS-205/CSM-101 mission is to launch and insert the manned Block II Apollo spacecraft into a near earth orbit to verify the spacecraft/crew operations and subsystems performance for an orbital mission.

The planned mission profile and support plans reflect the requirements for the following primary objectives: (1) Demonstrate CSM/crew performance in an earth orbital environment; (2) Demonstrate crew/space vehicle/mission support facilities performance during an earth orbital mission; (3) Demonstrate the adequacy of the launch vehicle attitude control system for orbital operation; (4) Demonstrate CSM active rendezvous with the S-IVB/IU/SLA; (5) Demonstrate S-IVB orbital safing capability; (6) Evaluate S-IVB J-2 engine ASI line modification.

The secondary test objectives are: (1) Evaluate the S-IVB/IU orbital coast lifetime capability; (2) Demonstrate CSM manual launch vehicle orbital attitude control.

B. Mission Groundrules and Constraints:

The following mission criteria and vehicle constraints have been included in shaping the S-IB stage profile and in establishing the S-IVB terminal conditions: (1) Launch from AFETR Pad 34; (2) Pad oriented launch azimuth of 100 degrees east of north; (3) Flight azimuth of 72 degrees east of north; (4) S-IB stage tilt program shaped for load relief during high dynamic pressure region; (5) Guidance command angle rate limit of 1 deg/sec in pitch and yaw; (6) S-IVB cutoff conditions for a 120/150 nautical mile elliptical orbit insertion.

SECTION III. VEHICLE CHARACTERISTICS AND ENVIRONMENT

A. Configuration:

The AS-205/CSM-101 Saturn IB Launch Vehicle consists of a S-IB stage, a S-IVB stage, an instrument unit, and a payload. The payload consists of the Launch Escape System (LES), Command Module (CM), Service Module (SM), and a Spacecraft Lunar Module Adapter (SLA). An outboard profile of the complete configuration is shown in Figure 20.

B. Mass:

The AS-205 vehicle mass characteristics used to generate the operational trajectory are defined in Reference 1. Table 12 presents a vehicle weight breakdown of the launch vehicle and payload.

C. Propulsion:

The S-IB stage is powered by eight H-1 engines which have a nominally rated sea level thrust of 200,000 pounds each. The predicted thrust history for each H-1 engine including thrust decay and the associated turbine engine thrust were obtained from Reference 2.

The S-IVB stage is powered by a single J-2 engine which has a rated vacuum thrust of 200,000 pounds at a nominal mixture ratio of 5:1. The S-IVB stage has an open loop propellant utilization system which is set for a mixture ratio of 5.5 to 1 and a corresponding thrust for approximately 300 seconds. The mixture ratio then shifts to 4.5 to 1 for the remainder of the S-IVB stage. The predicted J-2 engine thrust history from 90% thrust to Guidance Cutoff Signal (GCS) was obtained from Reference 2. The thrust buildup and decay histories were obtained from References 4 and 5.

The S-IB stage is decelerated at separation by four solid propellant retro-motors (TE-M-29) mounted on the S-IB/S-IVB interstage. These motors nominally provide 36,720 pounds of thrust each (Reference 6).

There are three solid propellant ullage motors mounted on the S-IVB aft portion to provide the necessary positive acceleration to settle the S-IVB stage propellants for J-2 engine start. These motors are rated at 3460 pounds of thrust each (Reference 7).

The S-IVB Stage Auxiliary Propulsion System (APS) provides roll control during J-2 burn and pitch, yaw, and roll control during the orbital portion. The APS consists of two modules, each containing three 150 pound thrust (vacuum) hypergolic rocket engines.

D. Aerodynamics:

Aerodynamic data for the S-IB and S-IVB stages of powered flight were obtained from Reference 8. Reference 9 presents the orbital drag data.

E. Environment Description:

The 1963 Patrick Reference Atmosphere Model defines the atmospheric properties incorporated in the trajectory simulation. The earth model and potential function are those of the Fischer Earth Model. Since the planned launch date is for a "low wind period," the S-IB stage tilt program is not wind biased. However, the median wind for the month of October was included in the trajectory. The wind profile was derived from Reference 10 and presented graphically in Figure 16.

SECTION IV. GUIDANCE AND CONTROL

The Saturn IB inertial guidance system performs navigation evaluations, issues discrete commands, initiates certain guidance and control functions, and issues steering commands to guide the launch vehicle to the pre-specified terminal conditions.

A. Guidance:

The AS-205/CSM-101 Launch Vehicle guidance is divided into three phases: (1) Pre-IGM; (2) IGM; (3) Orbital.

The Pre-IGM phase provides guidance commands in pitch, yaw, and roll from lift-off to the time of IGM initiation. The S-IB pitch program polynomials and the yaw and roll command histories are presented in Appendix B.

The S-IVB stage is steered to the desired terminal conditions by the Iterative Guidance Mode (IGM). The IGM equations and logic which provide guidance in pitch and yaw are initiated at TB3 + 25 seconds. The IGM constants are presented in Table 3B.

The orbital guidance mode provides pitch, yaw, and roll attitude commands during the orbital phase. The orbital maneuvers are presented in Table 2A.

B. Control:

The S-IB stage is controlled in pitch, yaw, and roll by four swivelable H-1 engines. The S-IB stage control law, gains, and network characteristics are given in Reference 11.

The J-2 engine provides pitch and yaw attitude control throughout S-IVB powered flight. The Auxiliary Propulsion System provides the roll control. The S-IVB control data are presented in Reference 11.

SECTION V. TRAJECTORY DESCRIPTION

A. Powered Flight:

All of the detailed trajectory information is based on an unbiased S-IB tilt program. Table 1 presents the nominal sequence of events for the AS-205/CSM-101 Launch Vehicle Operational Trajectory. Table 2 presents a summary of trajectory parameters at pertinent events from GRR to loss of S-IVB/IU attitude control. Tables 3 and 4 present convenient summaries of the S-IB and S-IVB stage end conditions. Detailed tabular listings are contained in Tables 5 - 9 and Appendix C. Graphical displays of various trajectory parameters are presented in Figures 1 - 15.

The S-IB launch phase begins at Guidance Reference Release, which is assumed to be 5 seconds prior to first motion, and ends at S-IB/S-IVB physical separation. Separation occurs at 144.49 seconds after first motion.

During the S-IB powered flight phase, a constant thrust bias of .4 per cent of the vehicle sea level longitudinal thrust is included. This is an attempt to minimize the effects of an apparent systematic shift in the ground to flight test performance level.

The S-IVB stage J-2 engine start command is issued 2.7 seconds after the S-IB stage outboard engines cut off. Approximately 25 seconds after outboard engine cutoff, the Iterative Guidance Mode is initiated and steers the S-IVB stage to the desired terminal conditions. These terminal conditions are nominally reached approximately 614.6 seconds after first motion.

B. Orbital Phase:

The orbital phase begins ten seconds after Guidance Cutoff Signal (GCS) and continues through the guaranteed S-IVB/IU lifetime. During the orbital

phase the S-IVB stage is required to perform certain attitude maneuvers. This is accomplished by the APS. Detailed information concerning the orbital maneuvers is presented in Appendix A. The orbital trajectory is listed in Table 8.

C. Spent Stage:

This portion of flight is initiated when the four retro-rockets are ignited at S-IB/S-IVB separation. The S-IB spent stage re-entry trajectory is presented in Table 9.

SECTION VI. LAUNCH VEHICLE PERFORMANCE SUMMARY

The predicted S-IB and S-IVB stage performance characteristics presented in Table 11. These data are time averages of the detailed vehicle performance data presented in Reference 2. These data are to be used in post-flight trajectory analysis.

SECTION VII. TRACKING SUMMARY

The tracking and telemetry station coordinates are presented in Table 10. A summary of the launch and orbital timeline is presented in Figure 19. The associated orbital ground projection is given in Figure 17.

SECTION VIII. DISPERSION SUMMARY

Tables 13 and 14 present the $\pm 3 \sigma$ dispersions for certain trajectory parameters at S-IB/S-IVB separation and S-IVB cutoff, respectively. These data are extracts from the data to be presented in the "AS-205/CSM-101 Launch Vehicle Dispersion Analysis, Revision 1."

SECTION IX

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11. "Control Gains and Shaping Networks for AS-205, AS-207, and AS-209, S-IB and S-IVB Stages," R-ASTR-F-68-15, February 7, 1968.

TABLE 1
AS-205/CSM-101 LAUNCH VEHICLE OPERATIONAL TRAJECTORY
FLIGHT SEQUENCE OF EVENTS

<u>Nominal Flight Time</u> <u>(HR:MIN:SEC)</u>	<u>(SEC)</u>	<u>Program</u> <u>Time (SEC)</u>	<u>Event</u>
- 0:0:05.0	- 5.00	-----	Guidance Reference Release (GRR)
- 0:0:03.1	- 3.10	-----	Initiate S-IB mainstage ignition sequence.
0:0:00.0	0.00	-----	First motion.
0:0:00.2	0.20	(0.0) ₁	Lift-off signal; initiate Time Base 1.
0:0:10.2	10.20	(10.0) ₁	Initiate pitch and roll maneuvers.
0:1:15.0	75.0	-----	Maximum dynamic pressure.
0:1:40.2	100.20	(100.0) ₁	Control gain switch point.
0:2:00.2	120.20	(120.0) ₁	Control gain switch point.
0:2:13.9	133.91	(133.71) ₁	Enable S-IB propellant level sensors.
0:2:14.5	134.50	(134.3) ₁	Tilt arrest.
0:2:16.9	136.91	(0.0) ₂	Level sensor activation; Initiate Time Base 2.
0:2:20.1	140.11	(3.2) ₂	Inboard engine cutoff (IECO).
0:2:23.1	143.11	(0.0) ₃	Outboard engine cutoff (OECO); Initiate Time Base 3.
0:2:24.4	144.41	(1.3) ₃	Separation signal.
0:2:24.5	144.49	-----	S-IB/S-IVB physical separation.
0:2:25.8	145.81	(2.7) ₃	J-2 engine start command.
0:2:28.2	148.16	-----	Ullage burn out.
0:2:29.4	149.41	-----	90% J-2 thrust level.
0:2:31.8	151.81	(8.7) ₃	Command P. U. system activation.
0:2:36.4	156.41	(13.3) ₃	Jettison ullage rocket motors.
0:2:43.1	163.11	-----	Jettison launch escape tower.

TABLE 1 (Cont'd)
AS-205/CSM-101 LAUNCH VEHICLE OPERATIONAL TRAJECTORY
FLIGHT SEQUENCE OF EVENTS

<u>Nominal Flight Time</u> <u>(HR:MIN:SEC)</u>	<u>Time</u> <u>(SEC)</u>	<u>Program</u> <u>Time (SEC)</u>	<u>Event</u>
0:2:48.1	168.11	(25.0) ₃	Command IGM initiation.
0:5:43.1	343.11	(200.0) ₃	Control gain switch point.
0:7:34.4	454.41	(311.3) ₃	Command mixture ratio shift.
0:10:14.6	614.63	-----	Guidance cutoff signal (GCS).
0:10:14.8	614.83	(0.0) ₄	Initiate Time Base 4 (Reflects an approximate 0.2 second systems delay).
0:10:24.6	624.63	-----	Orbital insertion.
1:34:26.8	5666.83	(5052.0) ₄	Initiate LOX dump.
1:42:26.8	6146.83	(5532.0) ₄	Initiate cold helium dump..
1:46:27.8	6387.83	(5773.0) ₄	Completion of LOX dump.
2:30:14.8	9014.83	(8400.0) ₄	Termination of cold helium dump.
2:29:55.0	8995.00	-----	Begin manual control of S-IVB attitude from spacecraft.
2:32:55.0	9175.00	-----	End manual control of S-IVB attitude from spacecraft; return control to I. U.
2:54:55.0	10495.00	-----	Nominal CSM physical separation.
3:17:31.8	11851.83	(11237.0) ₄	Start stage control sphere helium dump.
4:30:14.8	16214.83	(15,600.0) ₄	Restart cold helium dump.
4:41:22.1	16882.13	(16,267.3) ₄	Completion of stage control sphere helium dump.
4:50:14.8	17414.83	(16,800.0) ₄	Completion of cold helium dump.

TABLE 2

AS-205/CSM-101 LAUNCH VEHICLE OPERATIONAL TRAJECTORY SUMMARY

Event	Flight Time (sec)	Altitude (km)	S.F. Velocity (m/sec)	S.F. Flight Path Angle (deg)	S.F. Azimuth (deg)	Geodetic Lat Pos. North (deg)	Longitud (Pos East (deg)
Guidance Ref. Release	- 5.0	0.03	408.97	90.000	90.00	28.52	- 80.56
First Motion	0.0	0.03	408.97	90.000	90.00	28.52	- 80.56
Max. Dyn. Pressure	75.0	12.32	742.13	58.219	83.41	28.53	- 80.52
Wilt Arrest	134.5	51.77	2066.79	61.964	76.10	28.65	- 80.11
Inboard Engine Cutoff	140.1	57.41	2267.77	61.722	75.77	28.67	- 80.02
Outboard Engine Cutoff	143.1	60.55	2325.01	63.168	75.70	28.69	- 79.98
S-IB/S-IVB Physical S	144.5	62.00	2325.84	63.420	75.70	28.69	- 79.96
J-2 Eng. Start Command	145.8	63.36	2320.54	63.675	75.71	28.70	- 79.94
Ullage Case Jettison	156.4	73.91	2334.08	65.569	75.73	28.75	- 79.96
Initiate IGM	168.25	85.02	2377.35	67.534	75.72	28.80	- 79.56
EMR Sensed by IGM	454.8	219.16	4973.77	88.104	80.73	30.52	- 71.30
S-IB Stage Impact	556.2	0.	413.00	102.590	90.08	29.79	- 75.64
Guidance C/O Signal	614.6	227.94	7780.67	90.007	85.90	31.53	- 61.99
Orbit Insertion	624.6	227.95	7787.41	90.002	86.31	31.58	- 61.24
CSM Separation	10495.0	240.22	7779.86	90.282	60.87	12.99	- 164.41

TABLE 3
AS-205/CSM-101 LAUNCH VEHICLE OPERATIONAL TRAJECTORY
S-IB STAGE END CONDITIONS OF FLIGHT

Flight Time: OECO + 1.379 Seconds	144.49	(sec)
Radius:	6435263.	(m)
Altitude:	61995.	(m)
Space Fixed Velocity:	2325.84	(m/sec)
Space Fixed Path Angle:	63.420	(deg)
Space Fixed Flight Azimuth:	75.70	(deg)
Earth Fixed Flight Azimuth:	72.23	(deg)
Geocentric Declination: (Pos. North)	28.53	(deg)
Geodetic Latitude: (Pos. North)	28.69	(deg)
Longitude: (Pos. East)	- 79.96	(deg)

Space Fixed Position and Velocity Components

X	=	6434124.	(m)
Y	=	35609.	(m)
Z	=	115707.	(m)
DX	=	1002.54	(m/sec)
DY	=	118.63	(m/sec)
DZ	=	2095.32	(m/sec)

Vehicle Attitude and Attitude Rate

Pitch Attitude Angle	=	- 59.31	(deg)
Yaw Attitude Angle	=	- 0.07	(deg)
Roll Attitude Angle	=	0.00	(deg)
Pitch Rate	=	0.00	(deg/sec)
Yaw Rate	=	0.00	(deg/sec)
Roll Rate	=	0.00	(deg/sec)

TABLE 4

AS-205/CSM-101 LAUNCH VEHICLE OPERATIONAL TRAJECTORY
S-IVB STAGE END CONDITIONS OF FLIGHT

Flight Time: GCS	614.63	(sec)
Radius:	6600292.	(m)
Altitude:	227941.	(m)
Space Fixed Velocity:	7780.67	(m/sec)
Space Fixed Path Angle:	90.007	(deg)
Space Fixed Flight Azimuth:	85.90	(deg)
Earth Fixed Flight Azimuth:	85.67	(deg)
Geocentric Declination: (Pos. North)	31.37	(deg)
Geodetic Latitude: (Pos. North)	31.53	(deg)
Longitude: (Pos. East)	61.99	(deg)
Inclination:	31.605	(deg)
Descending Node Argument	119.0	(deg)

Space Fixed Position and Velocity Components

X	=	6258278.	(m)
Y	=	144698.	(m)
Z	=	2092098.	(m)
DX	=	- 2472.80	(m/sec)
DY	=	412.48	(m/sec)
DZ	=	7365.73	(m/sec)

Vehicle Attitude Angles

Pitch Attitude Angle	=	- 105.87	(deg)
Yaw Attitude Angle	=	3.37	(deg)
Roll Attitude Angle	=	- .36	(deg)

Osculating Conic Parameters

*Perigee Altitude	=	222.11	(km)
*Apogee Altitude	=	254.42	(km)
Eccentricity	=	.0024	
Semi-major Axis	=	6616.43	(km)
True Anomaly	=	357.26	(deg)
Period	=	89.27	(min)

*Referenced to Equatorial Radius (6378.165 km)

TABLE 4 (Cont'd)
AS-205/CSM-101 LAUNCH VEHICLE OPERATIONAL TRAJECTORY
S-IVB STAGE END CONDITIONS OF FLIGHT

Flight Time: Orbit Insertion	624.63	(sec)
Radius:	6600287.	(m)
Altitude:	227951.	(m)
Space Fixed Velocity:	7787.41	(m/sec)
Space Fixed Path Angle:	90.002	(deg)
Space Fixed Flight Azimuth:	86.31	(deg)
Earth Fixed Flight Azimuth:	86.11	(deg)
Geocentric Declination: (Pos. North)	31.41	(deg)
Geodetic Latitude: (Pos. North)	31.58	(deg)
Longitude: (Pos. East)	61.24	(deg)
Inclination:	31.605	(deg)
Descending Node Argument	119.0	(deg)

Space Fixed Position and Velocity Components

X	=	6233099.	(m)
Y	=	148816.	(m)
Z	=	2165667.	(m)
DX	=	-2561.23	(m/sec)
DY	=	410.93	(m/sec)
DZ	=	7342.68	(m/sec)

Vehicle Attitude Angles

Pitch Attitude Angle	=	-105.86	(deg)
Yaw Attitude Angle	=	3.36	(deg)
Roll Attitude Angle	=	-.69	(deg)

Osculating Conic Parameters.

*Perigee Altitude	=	222.12	(km)
*Apogee Altitude	=	277.47	(km)
Eccentricity	=	.0042	
Semi-major Axis	=	6627.96	(km)
True Anomaly	=	359.61	(deg)
Period	=	89.50	(min)

*Referenced to Equatorial Radius (6378.165 km)

TABLE 5

S-IB POWERED FLIGHT TABLES

TIME	ALT	RRR	VTH*	VVV*	AZ*	ANI
(SEC)	(M)	(M)	(DEG)	(M/S)	(DEG)	G=M2/M-RAD)
-5.00	34.	6373356.	90.00	408.97	90.00	0.
0.00	34.	6373356.	90.00	408.97	90.00	0.
5.00	65.	6373386.	88.22	409.12	89.99	100.
10.00	165.	6373466.	86.15	409.73	89.98	1866.
15.00	343.	6373665.	83.82	411.26	89.97	11043.
20.00	611.	6373932.	81.23	414.56	89.93	40562.
25.00	979.	6374300.	78.44	420.40	89.83	113960.
30.00	1457.	6374779.	75.51	429.60	89.65	268643.
35.00	2057.	6375379.	72.55	443.00	89.34	558323.
40.00	2789.	6376111.	69.65	461.27	88.92	1055356.
45.00	3665.	6376986.	66.93	484.92	88.36	1850850.
50.00	4693.	6378014.	64.48	514.39	87.68	3051491.
55.00	5884.	6379205.	62.37	549.74	86.91	4772908.
60.00	7244.	6380565.	60.71	590.22	86.07	7115698.
65.00	8770.	6382089.	59.00	634.40	85.21	10104790.
70.00	10459.	6383778.	58.80	684.72	84.32	13729510.
75.00	12322.	6385640.	58.22	742.13	83.42	17988484.
80.00	14374.	6387691.	57.82	806.91	82.53	22823860.
85.00	16620.	6389742.	57.57	879.13	81.68	28054564.
90.00	19092.	6392406.	57.56	959.43	80.88	33282835.
95.00	21779.	6395091.	57.72	1048.13	80.11	38116691.
100.00	24697.	6398006.	58.01	1145.07	79.41	42425169.
105.00	27853.	6401160.	58.40	1250.36	78.77	46143030.
110.00	31257.	6404561.	58.86	1364.24	78.20	49242733.
115.00	34916.	6408212.	59.37	1487.18	77.60	51724947.
120.00	38843.	6412139.	59.97	1619.92	77.21	53663070.
125.00	43036.	6416328.	60.62	1763.12	76.79	55139568.
130.00	47504.	6420790.	61.32	1917.51	76.41	56247171.
134.50	51766.	6425047.	61.90	2066.79	76.10	56985417.
135.00	52253.	6425534.	62.04	2084.02	76.07	57076956.
140.00	57294.	6430560.	62.71	2263.67	75.78	57697244.
1) 140.11	57409.	6430662.	62.72	2267.77	75.77	57703813.
2) 143.11	60551.	6433020.	63.17	2325.01	75.70	57981080.
144.41	61913.	6435180.	63.40	2326.09	75.70	58071429.
3) 144.49	61996.	6435263.	63.42	2325.84	75.70	58078837.

1) Inboard Cutoff

2) Outboard Cutoff

3) Separation

TABLE 5
S-IB POWERED FLIGHT TABLES

TIME	MASS	THRUST	VTHE	AZI	RANGE	VVVE
(SEC)	(KG)	(N)	(DEG)	(DEG)	(M)	(M/S)
5.00	585942.88	0.	N/A	N/A	0.	0.00
0.00	585942.88	6947027.	N/A	N/A	0.	0.00
5.00	572028.98	7150397.	0.40	N/A	0.	12.71
10.00	558115.08	7193815.	0.45	N/A	1.	27.48
15.00	544056.98	7261442.	0.28	N/A	2.	44.28
20.00	529998.88	7316200.	0.79	54.85	3.	63.18
25.00	515063.35	7365766.	2.09	66.75	10.	84.33
30.00	501727.82	7417116.	3.90	69.42	35.	107.74
35.00	487566.99	7474616.	6.15	70.29	88.	133.62
40.00	473406.14	7539665.	8.74	70.61	183.	162.26
45.00	459230.52	7607769.	11.58	70.82	340.	193.95
50.00	445054.89	7677844.	14.59	71.02	580.	229.02
55.00	430878.66	7746457.	17.70	71.18	925.	267.61
60.00	416702.42	7805254.	20.84	71.30	1401.	308.98
65.00	402478.96	7865551.	24.04	71.40	2031.	351.56
70.00	388255.51	7930847.	27.25	71.50	2841.	398.94
75.00	374011.93	7989454.	30.33	71.67	3865.	452.87
80.00	359774.40	8039101.	33.25	71.63	5136.	513.80
85.00	345577.93	8079779.	35.95	71.69	6688.	582.04
90.00	331381.46	8107523.	38.54	71.75	8558.	658.01
95.00	317244.66	8124984.	41.03	71.80	10790.	742.03
100.00	303107.67	8131797.	43.36	71.85	13426.	834.28
105.00	288996.11	8131104.	45.52	71.89	16509.	934.99
110.00	274884.36	8124551.	47.51	71.93	20082.	1044.48
115.00	260820.53	8111827.	49.36	71.97	24189.	1163.20
120.00	246756.72	8091718.	51.12	72.02	28877.	1291.74
125.00	232766.23	8069348.	52.81	72.05	34202.	1430.83
130.00	218775.74	8040994.	54.41	72.09	40218.	1581.24
134.50	206285.79	8008082.	55.77	72.13	46273.	1727.07
135.00	204898.02	8003879.	55.92	72.13	46985.	1743.93
140.00	191020.28	7942386.	57.24	72.18	54565.	1920.15
1) 140.11	190716.96	7947549.	57.31	72.18	54741.	1924.18
2) 143.11	185661.95	7880063.	57.98	72.22	59650.	1979.45
144.41	184858.35	208807.	58.26	72.23	61817.	1979.60
3) 144.49	184846.19	197848.	58.28	72.23	61948.	1979.29

- 1) Inboard Cutoff
- 2) Outboard Cutoff
- 3) Separation

TABLE- 5

S-IB POWERED FLIGHT TABLES

TIME	X	Y	Z	DX	DY	DZ
(SEC)	(M)	(M)	(M)	(M/S)	(M/S)	(M/S)
5.00	6373331.	17047.	5539.	0.00	126.38	388.95
0.00	6373330.	17679.	-3594.	0.00	126.31	388.98
5.00	6373360.	18310.	-1649.	12.44	126.20	388.97
10.00	6373450.	18941.	295.	27.09	126.08	388.91
15.00	6373634.	19571.	2240.	43.76	126.04	389.02
20.00	6373899.	20201.	4187.	62.52	125.99	389.97
25.00	6374263.	20831.	6142.	83.43	125.98	392.29
30.00	6374737.	21461.	8113.	106.56	125.95	396.65
35.00	6375332.	22091.	10113.	131.78	125.89	403.78
40.00	6376059.	22720.	12157.	159.14	125.75	414.28
45.00	6376927.	23348.	14262.	188.59	125.59	428.73
50.00	6377948.	23976.	16452.	220.01	125.44	447.73
55.00	6379130.	24603.	18748.	253.07	125.29	471.67
60.00	6380480.	25229.	21170.	286.61	125.13	500.55
65.00	6381993.	25854.	23761.	318.56	124.97	534.20
70.00	6383668.	26478.	26529.	351.77	124.81	574.04
75.00	6385515.	27102.	29513.	387.48	124.62	620.56
80.00	6387547.	27725.	32746.	425.70	124.44	674.09
85.00	6389776.	28346.	36265.	466.44	124.25	734.75
90.00	6392214.	28967.	40108.	509.09	124.05	803.70
95.00	6394669.	29567.	44317.	553.10	123.82	881.66
100.00	6397746.	30205.	48939.	598.62	123.58	968.20
105.00	6400858.	30823.	54015.	645.61	123.27	1063.67
110.00	6404206.	31438.	59590.	694.12	122.92	1168.01
115.00	6407301.	32052.	65711.	743.93	122.52	1281.89
120.00	6411647.	32663.	72427.	794.33	122.09	1406.51
125.00	6415745.	33272.	79795.	845.22	121.44	1542.54
130.00	6420100.	33877.	87872.	896.69	120.68	1690.63
134.50	6424240.	34419.	95801.	943.55	119.96	1834.93
135.00	6424713.	34479.	96723.	948.79	119.88	1851.64
140.00	6429592.	35076.	104410.	1003.89	119.02	2025.39
1) 140.11	6429702.	35089.	106633.	1005.18	119.00	2029.34
2) 143.11	6432733.	35446.	112820.	1012.33	118.70	2089.68
144.41	6434045.	35600.	115542.	1003.26	118.63	2095.26
3) 144.49	6434124.	35609.	115707.	1002.54	118.63	2095.32

- 1) Inboard Cutoff
- 2) Outboard Cutoff
- 3) Separation

TABLE 5

S-IB POWERED FLIGHT TABLES

TIME	XE	YE	ZE	DxE	DYE	DZE
(SEC)	(M)	(M)	(M)	(M/S)	(M/S)	(M/S)
-5.00	35.	-0.	-0.	-0.00	0.00	-0.00
0.00	35.	-0.	-0.	-0.00	-0.00	0.00
5.00	45.	-0.	-0.	-12.71	-0.05	-0.04
10.00	165.	-0.	-0.	27.48	-0.10	-0.15
15.00	343.	-1.	-1.	44.28	-0.09	-0.10
20.00	611.	-2.	-0.	63.18	-0.09	0.77
25.00	979.	-2.	-9.	84.27	-0.06	3.00
30.00	1457.	-2.	33.	107.50	-0.04	7.23
35.00	2057.	-2.	65.	132.87	-0.07	14.20
40.00	2790.	-3.	181.	160.40	-0.17	24.52
45.00	3665.	-4.	337.	190.04	-0.30	38.76
50.00	4693.	-6.	576.	221.68	-0.40	57.51
55.00	5885.	-8.	921.	255.00	-0.49	81.17
60.00	7244.	-11.	1396.	288.83	-0.58	109.74
65.00	8770.	-14.	2025.	321.13	-0.65	143.04
70.00	10458.	-17.	2837.	354.75	-0.70	182.51
75.00	12321.	-21.	3862.	390.93	-0.76	228.61
80.00	14372.	-25.	5134.	429.71	-0.77	281.68
85.00	16623.	-29.	6690.	471.10	-0.76	341.82
90.00	19086.	-32.	8566.	514.49	-0.72	410.21
95.00	21770.	-36.	10807.	559.37	-0.65	487.56
100.00	24683.	-39.	13456.	605.88	-0.54	573.52
105.00	27832.	-41.	16557.	654.00	-0.43	668.20
110.00	31225.	-43.	20153.	703.79	-0.30	771.76
115.00	34872.	-44.	24290.	755.06	-0.14	884.82
120.00	38777.	-44.	29019.	807.09	0.06	1008.57
125.00	42944.	-43.	34395.	859.83	0.18	1143.67
130.00	47377.	-42.	40476.	913.36	0.29	1290.78
134.50	51597.	-41.	46603.	962.29	0.45	1434.15
135.00	52079.	-40.	47324.	967.77	0.47	1450.76
140.00	57058.	-38.	56005.	1025.45	0.72	1623.40
1) 140.11	57172.	-37.	55184.	1026.80	0.73	1627.32
2) 143.11	60270.	-35.	60163.	1035.17	0.97	1687.20
144.41	61611.	-34.	62362.	1026.45	1.08	1692.69
3) 144.49	61692.	-34.	62496.	1025.76	1.09	1692.25

- 1) Inboard Cutoff
- 2) Outboard Cutoff
- 3) Separation

TABLE 5
S-IB POWERED FLIGHT TABLES

TIME	PHIP	PHIY	PHIR	DPHIP	DPHIY	DPHIR
(SEC)	(DEG)	(DEG)	(DEG)	(DEG/S)	(DEG/S)	(DEG/S)
5.00	0.00	0.00	26.00	0.00	0.00	0.00
0.00	-0.02	0.01	27.99	-0.00	0.00	0.00
5.00	0.02	0.02	26.01	0.01	0.01	0.01
10.00	0.02	0.02	26.00	0.00	0.00	0.01
15.00	-0.55	-0.05	24.66	-0.12	-0.04	1.53
20.00	-1.40	0.07	19.17	-0.23	0.00	0.86
25.00	-2.74	0.07	14.11	-0.31	0.00	0.98
30.00	-4.49	0.05	9.13	-0.39	-0.01	1.00
35.00	-6.62	-0.02	4.13	-0.46	-0.01	1.00
40.00	-9.03	-0.03	-0.19	-0.51	-0.01	0.06
45.00	-11.68	-0.03	-0.01	-0.55	0.00	0.00
50.00	-14.51	-0.03	-0.01	-0.58	-0.00	0.00
55.00	-17.43	-0.03	-0.01	-0.59	-0.00	0.00
60.00	-20.39	-0.04	-0.01	-0.60	-0.00	0.00
65.00	-23.54	-0.04	-0.02	-0.62	-0.00	0.00
70.00	-26.56	-0.05	-0.02	-0.59	-0.00	0.00
75.00	-29.45	-0.05	-0.02	-0.62	-0.00	0.00
80.00	-32.59	-0.05	-0.01	-0.62	0.00	0.00
85.00	-35.77	-0.05	-0.00	-0.64	0.00	0.00
90.00	-38.84	-0.05	0.00	-0.59	0.00	0.00
95.00	-41.52	-0.04	0.00	-0.50	0.00	0.00
100.00	-43.93	-0.04	0.00	-0.46	0.00	0.00
105.00	-46.12	-0.06	-0.00	-0.42	-0.00	0.00
110.00	-48.15	-0.06	-0.00	-0.39	-0.00	0.00
115.00	-50.44	-0.06	-0.00	-0.47	-0.00	0.00
120.00	-52.72	-0.07	-0.00	-0.45	-0.00	0.00
125.00	-55.00	-0.16	-0.00	-0.42	-0.01	0.00
130.00	-57.08	-0.15	-0.00	-0.41	-0.00	0.00
134.50	-58.89	-0.15	-0.00	-0.40	-0.00	0.00
135.00	-59.08	-0.15	-0.00	-0.37	-0.00	0.00
140.00	-59.31	-0.16	-0.00	-0.01	-0.00	0.00
1) 140.11	-59.31	-0.16	-0.00	-0.01	-0.00	0.00
2) 143.11	-59.32	-0.08	-0.00	-0.01	-0.01	0.00
144.41	-59.31	-0.07	-0.00	0.00	0.00	0.00
3) 144.49	-59.31	-0.07	-0.00	0.00	0.00	0.00
1) Inboard Cutoff						
2) Outboard Cutoff						
3) Separation						

TABLE 5

S-IB POWERED FLIGHT TABLES

TIME	CHIP	CHIY	CHIR	LONG	DECL	LATT
(SEC)	(DEG)	(DEG)	(DEG)	(DEG)	(DEG)	(DEG)
5.00	0.00	0.00	0.00	-80.56	28.36	28.52
10.00	0.00	0.00	-28.00	-80.56	28.36	28.52
15.00	0.00	0.00	-28.00	-80.56	28.36	28.52
20.00	0.00	0.00	-28.00	-80.56	28.36	28.52
25.00	0.67	0.00	-23.20	-80.56	28.36	28.52
30.00	-1.66	0.00	-18.20	-80.56	28.36	28.52
35.00	-3.10	0.00	-13.20	-80.56	28.36	28.52
40.00	-4.93	0.00	-8.20	-80.56	28.36	28.52
45.00	-7.11	0.00	-3.20	-80.56	28.36	28.52
50.00	-9.58	0.00	0.00	-80.56	28.36	28.52
55.00	-12.30	0.00	0.00	-80.56	28.36	28.52
60.00	-15.21	0.00	0.00	-80.56	28.36	28.52
65.00	-18.27	0.00	0.00	-80.56	28.36	28.52
70.00	-21.43	0.00	0.00	-80.55	28.36	28.53
75.00	-24.62	0.00	0.00	-80.54	28.37	28.53
80.00	-27.79	0.00	0.00	-80.53	28.37	28.53
85.00	-30.90	0.00	0.00	-80.52	28.37	28.53
90.00	-33.89	0.00	0.00	-80.51	28.38	28.54
95.00	-36.76	0.00	0.00	-80.50	28.38	28.54
100.00	-39.47	0.00	0.00	-80.48	28.39	28.55
105.00	-42.03	0.00	0.00	-80.46	28.39	28.55
110.00	-44.41	0.00	0.00	-80.43	28.40	28.56
115.00	-46.60	0.00	0.00	-80.40	28.41	28.57
120.00	-48.59	0.00	0.00	-80.37	28.42	28.58
125.00	-50.95	0.00	0.00	-80.33	28.43	28.59
130.00	-53.21	0.00	0.00	-80.28	28.44	28.60
135.00	-55.40	0.00	0.00	-80.23	28.46	28.62
140.00	-57.50	0.00	0.00	-80.17	28.47	28.63
143.00	-59.32	0.00	0.00	-80.11	28.49	28.65
146.00	-59.32	0.00	0.00	-80.10	28.49	28.65
149.00	-59.32	0.00	0.00	-80.03	28.51	28.67
152.00	-59.32	0.00	0.00	-79.98	28.53	28.68
155.00	-59.32	0.00	0.00	-79.96	28.53	28.69
158.00	-59.32	0.00	0.00	-79.96	28.53	28.69

1) Inboard Cutoff

2) Outboard Cutoff

3) Separation

TABLE 5

S-IB POWERED FLIGHT TABLES

TIME	MACH	DRAG	ALP	QQW	VR	TACEL
(SEC)	(U)	(N)	(DEG)	(N/M2)	(M/S)	(M/S2)
-5.00	0.00	23.	N/A	1.	0.00	0.00
0.00	0.00	23.	N/A	1.	1.22	11.93
5.00	0.04	27.27.	4.70	96.	12.76	12.57
10.00	0.08	11961.	2.07	441.	27.50	12.94
15.00	0.13	30239.	1.00	1126.	44.30	13.36
20.00	0.16	45382.	0.68	2238.	63.22	13.79
25.00	0.25	61067.	0.52	3853.	84.40	14.24
30.00	0.32	85783.	0.01	6003.	107.82	14.69
35.00	0.39	114206.	0.32	8693.	133.64	15.17
40.00	0.48	146090.	-0.41	11891.	162.16	15.69
45.00	0.58	181289.	-0.51	15500.	193.59	16.25
50.00	0.69	220856.	-0.58	19374.	228.20	16.83
55.00	0.82	269903.	-0.62	23284.	266.09	17.36
60.00	0.96	528640.	-0.67	26777.	306.39	17.54
65.00	1.11	737423.	-0.87	29237.	347.38	17.79
70.00	1.29	668145.	-0.94	30886.	392.56	18.79
75.00	1.51	580164.	-0.74	31585.	444.57	19.90
80.00	1.76	489622.	-0.37	30869.	506.29	21.07
85.00	2.03	403269.	-0.14	28225.	579.01	22.30
90.00	2.28	312173.	0.14	23696.	658.81	23.61
95.00	2.53	233835.	0.07	19014.	743.94	24.96
100.00	2.81	171529.	0.03	14834.	836.61	26.36
105.00	3.11	121214.	-0.02	11266.	936.67	27.82
110.00	3.41	81842.	-0.14	8221.	1043.93	29.36
115.00	3.72	49768.	-0.53	5844.	1162.29	31.02
120.00	4.05	21763.	-0.99	4052.	1290.81	32.82
125.00	4.40	2487.	-1.51	2740.	1429.87	34.78
130.00	4.79	-7341.	-1.91	1865.	1580.27	36.92
134.50	5.26	-13883.	-2.28	1325.	1726.08	39.03
135.00	5.32	-14537.	-2.32	1275.	1742.93	39.28
140.00	6.00	-23117.	-1.11	847.	1919.14	41.89
1) 140.11	6.01	-22964.	-1.08	839.	1923.17	41.94
2) 143.11	6.30	-16574.	-0.35	604.	1978.43	48.94
144.41	6.35	-13982.	-0.04	510.	1978.58	1.21
3) 144.49	6.36	-13434.	-0.02	504.	1978.27	1.15

- 1) Inboard Cutoff
 2) Outboard Cutoff
 3) Separation

TABLE 6					
ULLAGE AND J-2 BUILD-UP TABLES					
TIME	ALT	RRR	VTH°	VVV°	AZ°
(SEC)	(M)	(M)	(DEG)	(M/S)	(DEG)
144.49	61995.	6435263.	63.42	2325.84	75.70
145.81	63364.	6436630.	63.68	2320.54	75.71
148.08	65682.	6438944.	64.11	2312.92	75.73
149.41	67020.	6440281.	64.35	2314.09	75.74

TABLE. 6

ULLAGE AND J-2 BUILD-UP TABLES

TIME	MASS	THRUST	VTHE	AZI	RANGE	VVVE
(SEC)	(KG)	(N)	(DEG)	(DEG)	(M)	(M/S)
144.49	138789.72	41321.	58.28	72.23	61946.	1979.29
145.81	138683.39	41102.	58.56	72.25	64151.	1973.01
148.08	138489.22	437107.	59.06	72.27	67935.	1963.72
149.41	138403.47	838448.	59.34	72.29	70153.	1963.97

TABLE 6

ULLAGE AND J-2 BUILD-UP TABLES

TIME	X	Y	Z	UX	OY	OZ
(SEC)	(M)	(M)	(M)	(M/S)	(M/S)	(M/S)
144.49	6434124.	35609.	115707.	1007.54	118.63	2095.32
145.01	6435440.	35766.	118475.	990.02	118.57	2095.40
148.08	6437664.	36035.	123235.	969.21	118.48	2096.71
149.41	6438946.	36193.	126024.	959.94	118.41	2102.26

TABLE 6

ULLAGE AND J-2 BUILD-UP TABLES

TIME	X	Y	Z	DX	DY	DZ
(SEC)	(M)	(M)	(M)	(M/S)	(M/S)	(M/S)
144.49	6434124.	35609.	115707.	1002.54	118.63	2095.32
145.81	6435440.	35766.	118475.	990.02	118.57	2095.40
148.08	6437664.	36035.	125235.	969.21	118.48	2096.71
149.41	6438946.	36193.	126024.	959.94	118.41	2102.26

TABLE 6

ULLAGE AND J-2 BUILD-UP TABLES

TIME	PHIP	PHIY	PHIR	DPHIP	DPHIY	DPHIR
(SEC)	(DEG)	(DEG)	(DEG)	(DEG/S)	(DEG/S)	(DEG/S)
144.49	-59.31	-0.07	-0.00	0.00	0.00	-0.00
145.81	-59.30	-0.06	-0.00	0.02	0.01	0.00
148.08	-59.17	-0.05	-0.02	0.10	-0.01	-0.02
149.41	-59.03	-0.10	0.06	0.08	-0.06	0.05

TABLE 6
ULLAGE AND J-2 BUILD-UP TABLES

TIME	CHP	CHIY	CHIR	LONG	DECL	LATT
(SEC)	(DEG)	(DEG)	(DEG)	(DEG)	(DEG)	(DEG)
144.49	-59.32	0.00	0.00	-79.86	28.53	28.69
145.81	-59.32	0.00	0.00	-79.94	28.54	28.70
148.08	-59.32	0.00	0.00	-79.90	28.55	28.71
149.41	-59.32	0.00	0.00	-79.88	28.56	28.72

TABLE 6
ULLAGE AND J-2 BUILD-UP TABLES

TIME	CHIP	CHIY	CHIR	LONG	DECL	LATT
(SEC)	(DEG)	(DEG)	(DEG)	(DEG)	(DEG)	(DEG)
144.49	-59.32	0.00	0.00	-79.86	28.53	28.69
145.81	-59.32	0.00	0.00	-79.94	28.54	28.70
148.08	-59.32	0.00	0.00	-79.90	28.55	28.71
149.41	-59.32	0.00	0.00	-79.88	28.56	28.72

TABLE 7
S-IVB POWERED FLIGHT TABLES

TIME	ALT	RHR	VTH*	VVV*	AZ*	RANGLE
(SEC)	(M)	(M)	(DEG)	(M/S)	(DEG)	(DEG)
1) 149.41	67020.	6440281.	64.35	2314.09	75.74	0.63
150.00	67611.	6440671.	64.46	2315.27	75.74	0.64
156.41	73911.	6447161.	65.57	2334.08	75.73	0.74
163.11	80274.	6453519.	66.70	2357.27	75.73	0.84
170.00	86603.	6459833.	67.82	2384.42	75.72	0.95
190.00	103823.	6477022.	70.60	2469.93	75.93	1.28
210.00	119515.	6492682.	73.10	2568.01	76.17	1.63
230.00	133780.	6506913.	75.36	2679.04	76.44	2.01
250.00	146740.	6519799.	77.39	2803.25	76.73	2.41
270.00	158349.	6531412.	79.22	2940.61	77.04	2.83
290.00	168802.	6541829.	80.84	3091.70	77.36	3.28
310.00	178129.	6551118.	82.28	3257.19	77.70	3.76
330.00	186403.	6559332.	83.54	3437.17	78.05	4.27
350.00	193697.	6566606.	84.64	3633.17	78.42	4.81
370.00	200089.	6572957.	85.58	3845.96	78.81	5.39
390.00	205657.	6578483.	86.38	4076.58	79.22	6.00
410.00	210494.	6583276.	87.05	4327.82	79.66	6.66
430.00	214691.	6587429.	87.59	4600.81	80.12	7.37
450.00	218352.	6591045.	88.02	4896.83	80.61	8.12
2) 454.78	219155.	6591838.	88.10	4973.77	80.73	8.31
470.00	221493.	6594140.	88.49	5172.45	81.13	8.93
490.00	223903.	6596505.	88.94	5443.36	81.68	9.78
510.00	225601.	6598239.	89.27	5736.05	82.16	10.65
530.00	226907.	6599422.	89.56	6054.30	82.86	11.63
550.00	227437.	6600104.	89.79	6401.31	83.51	12.64
570.00	227960.	6600392.	89.94	6781.33	84.20	13.71
590.00	228040.	6600433.	90.01	7200.08	84.93	14.85
610.00	227949.	6600308.	90.04	7665.39	85.71	16.07
3) 614.63	227941.	6600272.	90.01	7780.67	85.90	16.36
4) 624.63	227951.	6600287.	90.00	7787.41	86.31	17.00

- 1) 90% Thrust
- 2) Mixture Ratio Shift
- 3) Guidance Cutoff
- 4) Orbit Insertion

TABLE 7

S-IVB POWERED FLIGHT TABLES

TIME	MASS	THRUST	VIEW	AZI	RANGE	YVVE
(SEC)	(KG)	(N)	(DEG)	(DEG)	(M)	(M/S)
1) 149.41	138403.47	833048.	58.34	72.29	70153.	1963.97
150.00	138271.21	877263.	59.46	72.29	71141.	1964.74
156.41	136600.50	1010827.	60.81	72.36	81979.	1979.37
163.11	135083.84	1010782.	62.18	72.43	93548.	1998.47
170.00	129337.14	1010049.	63.55	72.49	105714.	2021.72
190.00	124482.83	1007592.	66.98	72.94	142568.	2097.74
210.00	119617.47	1011531.	70.05	73.41	181742.	2188.13
230.00	114755.66	1010918.	72.82	73.89	223372.	2292.89
250.00	107891.32	1007098.	75.31	74.39	267616.	2412.05
270.00	105036.88	1011138.	77.52	74.89	314649.	2545.36
290.00	100185.92	1006414.	79.48	75.39	364670.	2693.23
310.00	95331.57	1010490.	81.19	75.90	417692.	2856.19
330.00	90489.84	1005229.	82.68	76.41	474556.	3034.17
350.00	85635.84	1009047.	83.96	76.93	534916.	3228.62
370.00	80789.01	1006358.	85.06	77.46	599264.	3440.19
390.00	75949.55	1006056.	85.98	78.01	667909.	3669.86
410.00	71100.91	1006154.	86.74	78.57	741208.	3920.36
430.00	66265.19	1005160.	87.36	79.15	819551.	4192.76
450.00	61428.44	1007769.	87.84	79.75	903382.	4490.31
29 2) 454.75	60286.96	1008089.	87.93	79.89	924153.	4565.15
470.00	57371.40	779446.	88.36	80.36	992866.	4763.52
490.00	53684.02	779103.	88.85	81.00	1087440.	5034.13
510.00	49997.24	779144.	89.22	81.66	1187430.	5326.59
530.00	46311.28	778924.	89.53	82.34	1293294.	5644.69
550.00	42626.33	778652.	89.78	83.04	1405561.	5991.60
570.00	38942.76	778266.	89.94	83.82	1524829.	6371.55
590.00	35261.50	777572.	90.01	84.63	1651792.	6790.25
610.00	31584.83	776228.	90.04	85.47	1787271.	7255.54
3) 614.63	30734.06	775758.	90.01	85.67	1819972.	7370.81
4) 624.63	30670.74	0.	90.00	86.11	1891173.	7377.54

- 1) 90% Thrust
- 2) Mixture Ratio Shift
- 3) Guidance Cutoff
- 4) Orbit Insertion

TABLE 7
S-IVB POWERED FLIGHT TABLES

TIME	X	Y	Z	DX	DY	DZ
(SEC)	(M)	(M)	(M)	(M/S)	(M/S)	(M/S)
1) 149.41	6438946.	36193.	126024.	959.94	118.41	2102.26
150.00	6439511.	36262.	127266.	956.17	118.37	2105.28
156.41	6445516.	37019.	140877.	918.09	117.70	2142.70
163.11	6451538.	37805.	155371.	879.55	116.99	2183.90
170.00	6457445.	38609.	170570.	841.13	116.14	2228.11
190.00	6473277.	40981.	216379.	741.37	121.69	2352.90
210.00	6487137.	43480.	264720.	645.10	128.38	2482.35
230.00	6499086.	46124.	315717.	549.84	136.26	2618.46
250.00	6509136.	48936.	369512.	454.96	145.02	2762.28
270.00	6517281.	51930.	426263.	359.57	154.49	2914.45
290.00	6523507.	55120.	486153.	262.66	164.57	3076.12
310.00	6527779.	58517.	549379.	164.19	175.29	3248.32
330.00	6530053.	62135.	616156.	62.66	186.63	3431.52
350.00	6530266.	65987.	686725.	42.06	198.68	3627.49
370.00	6528338.	70087.	761348.	151.55	211.46	3837.16
390.00	6524168.	74451.	840309.	266.37	225.05	4061.64
410.00	6517639.	79095.	923932.	387.85	239.57	4303.75
430.00	6508598.	84040.	1012580.	517.81	255.08	4564.46
450.00	6496862.	89386.	1106053.	657.57	271.77	4846.89
2) 454.75	6493656.	90607.	1129043.	692.44	275.93	4917.60
470.00	6482179.	94898.	1206251.	814.48	286.80	5099.86
490.00	6464199.	100779.	1310672.	985.22	301.21	5344.98
510.00	6442706.	106448.	1420163.	1166.83	315.79	5607.23
530.00	6417399.	113416.	1535087.	1367.18	331.21	5888.60
550.00	6387636.	120285.	1655060.	1587.56	348.00	6191.56
570.00	6353753.	127346.	1782915.	1829.69	366.35	6519.55
590.00	6314531.	134670.	1916827.	2097.14	386.29	6877.06
610.00	6269568.	142799.	2058200.	2401.23	407.19	7268.19
3) 614.63	6258278.	144698.	2092098.	2472.80	412.48	7365.73
4) 624.63	6233099.	148816.	2165667.	2561.23	410.93	7342.68

- 1) 90% Thrust
- 2) Mixture Ratio Shift
- 3) Guidance Cutoff
- 4) Orbit Insertion

TABLE 7
S-IVB POWERED FLIGHT TABLES

TIME	XE	YE	ZE	DXE	DYE	DZE
(SEC)	(M)	(M)	(M)	(M/S)	(M/S)	(M/S)
1) 149.41	66431.	-27.	70231.	904.37	1.49	1699.47
150.00	67211.	-26.	71835.	960.76	1.53	1702.44
156.41	73379.	-16.	82062.	944.56	1.80	1739.46
163.11	79585.	-2.	94653.	908.05	2.13	1780.26
170.00	85717.	-13.	107070.	871.79	2.38	1824.10
190.00	102206.	144.	144788.	778.59	11.36	1947.86
210.00	116841.	474.	165021.	689.43	21.86	2076.57
230.00	124792.	1030.	227897.	601.85	33.99	2212.23
250.00	140964.	1042.	273565.	515.31	47.46	2355.88
270.00	150485.	2936.	322189.	428.94	62.13	2508.19
290.00	158115.	4335.	373958.	341.83	77.94	2670.31
310.00	164075.	6062.	429074.	253.95	94.95	2843.29
330.00	166250.	8142.	487764.	163.92	113.25	3027.62
350.00	170619.	10601.	550268.	71.68	132.92	3225.08
370.00	171100.	13469.	616861.	-24.25	154.07	3436.65
390.00	169621.	16775.	687834.	-124.35	176.83	3663.48
410.00	166091.	20554.	763522.	-229.78	201.44	3908.43
430.00	160382.	24846.	844297.	-342.26	228.05	4172.54
450.00	152346.	29092.	930570.	-462.90	256.97	4458.99
2) 454.75	150076.	30929.	951920.	-492.97	264.21	4530.76
470.00	141751.	35115.	1022458.	-600.50	284.66	4716.94
490.00	128249.	41084.	1119278.	-751.20	312.43	4967.95
510.00	111660.	47621.	1221294.	-911.27	341.51	5236.94
530.00	91683.	54759.	1328889.	-1088.41	372.75	5526.20
550.00	67993.	62550.	1442493.	-1263.72	406.84	5838.30
570.00	40204.	71054.	1562596.	-1498.68	444.14	6176.84
590.00	7894.	80339.	1689773.	-1736.56	484.93	6546.50
610.00	-29540.	90468.	1824670.	-2008.36	528.93	6951.95
3) 614.63	-38992.	92944.	1857117.	-2071.97	539.90	7052.97
4) 624.63	-60119.	98370.	1927586.	-2152.18	544.89	7035.57

- 1) 90% Thrust
- 2) Mixture Ratio Shift
- 3) Guidance Cutoff
- 4) Orbit Insertion

TABLE 7
S-IVB POWERED FLIGHT TABLES

TIME	PHIP	PHIY	PHIR	DPHIP	DPHIY	DPHIR
(SEC)	(DEG)	(DEG)	(DEG)	(DEG/S)	(DEG/S)	(DEG/S)
1) 149.41	-59.03	0.10	0.06	0.08	0.06	0.05
150.00	-58.99	-0.14	0.09	0.06	-0.08	0.07
156.41	-59.08	-0.35	0.39	-0.03	0.02	0.06
163.11	-59.14	-0.31	0.45	-0.01	-0.00	0.00
170.00	-58.97	-0.06	-0.60	-0.44	-0.44	-0.03
190.00	-55.24	2.73	-0.33	-0.05	0.00	-0.05
210.00	-56.39	3.03	-0.00	-0.08	0.02	0.06
230.00	-57.96	3.28	0.26	-0.08	0.01	-0.04
250.00	-59.92	3.42	-0.47	-0.09	0.01	-0.04
270.00	-61.86	3.50	-0.07	-0.12	0.00	0.08
290.00	-64.00	3.55	-0.11	-0.10	0.00	-0.04
310.00	-66.26	3.59	-0.67	-0.12	0.00	-0.04
330.00	-66.51	3.63	-0.33	-0.11	0.00	0.08
350.00	-70.97	3.65	-0.22	-0.12	0.00	-0.05
370.00	-73.39	3.67	-0.22	-0.12	0.00	0.07
390.00	-75.85	3.68	0.30	-0.13	0.00	-0.04
410.00	-78.53	3.69	-0.53	-0.13	0.00	-0.04
430.00	-81.13	3.69	-0.05	-0.13	0.00	0.06
450.00	-83.83	3.69	-0.20	-0.14	0.00	-0.05
2) 454.75	-84.48	3.69	-0.05	-0.14	-0.00	-0.05
470.00	-86.91	3.81	-0.74	-0.14	-0.00	-0.06
490.00	-89.23	3.63	0.29	-0.08	-0.01	0.05
510.00	-92.24	3.52	-0.02	-0.18	-0.00	-0.05
530.00	-95.57	3.52	-0.45	-0.16	0.00	0.06
550.00	-98.53	3.54	-0.54	-0.14	0.00	-0.04
570.00	-101.32	3.52	-0.69	-0.14	-0.00	-0.06
590.00	-104.56	3.39	-0.26	-0.70	-0.08	-0.11
610.00	-105.88	3.37	-0.20	0.02	0.00	-0.04
3) 614.63	-105.67	3.37	-0.36	0.00	-0.00	-0.03
4) 624.63	-105.86	3.36	-0.69	0.00	-0.00	-0.03
1) 90% Thrust						
2) Mixture Ratio Shift						
3) Guidance Cutoff						
4) Orbit Insertion						

TABLE 7

S-IVB POWERED FLIGHT TABLES

TIME	CHIP	CHIY	CHIR	LONG	DECL	LATT
(SEC)	(DEG)	(DEG)	(DEG)	(DEG)	(DEG)	(DEG)
1) 147.41	-59.32	0.00	0.00	-79.88	28.56	28.72
150.00	-59.32	0.00	0.00	-79.87	28.56	28.72
156.41	-59.32	0.00	0.00	-79.76	28.59	28.75
163.11	-59.32	0.00	0.00	-79.65	28.62	28.78
170.00	-57.57	-1.75	0.00	-79.53	28.65	28.81
190.00	-55.40	-3.11	0.00	-79.17	28.75	28.91
210.00	-56.61	-3.45	0.00	-78.72	28.85	29.01
230.00	-58.18	-3.69	0.00	-78.38	28.96	29.12
250.00	-60.15	-3.84	0.00	-77.94	29.07	29.23
270.00	-62.14	-3.93	0.00	-77.47	29.18	29.34
290.00	-64.25	-4.00	0.00	-76.97	29.29	29.45
310.00	-66.55	-4.05	0.00	-76.44	29.41	29.57
330.00	-68.79	-4.09	0.00	-75.87	29.53	29.70
350.00	-71.22	-4.13	0.00	-75.27	29.66	29.82
370.00	-73.65	-4.16	0.00	-74.62	29.79	29.95
390.00	-76.12	-4.19	0.00	-73.92	29.92	30.08
410.00	-78.81	-4.21	0.00	-73.18	30.05	30.21
430.00	-81.42	-4.23	0.00	-72.38	30.19	30.35
450.00	-84.13	-4.24	0.00	-71.52	30.33	30.49
2) 454.75	-84.78	-4.24	0.00	-71.30	30.36	30.52
470.00	-87.21	-4.37	0.00	-70.60	30.47	30.63
490.00	-89.46	-4.19	0.00	-69.62	30.60	30.77
510.00	-92.59	-4.10	0.00	-68.59	30.74	30.90
530.00	-95.90	-4.12	0.00	-67.49	30.87	31.04
550.00	-98.65	-4.14	0.00	-66.33	31.00	31.16
570.00	-101.64	-4.13	0.00	-65.08	31.12	31.29
590.00	-105.65	-3.93	0.00	-63.75	31.24	31.40
610.00	-106.03	-4.01	0.00	-62.33	31.34	31.51
3) 614.63	-106.03	-4.01	0.00	-61.99	31.37	31.53
4) 624.63	-106.03	-4.01	0.00	-61.24	31.41	31.58

1) 90% Thrust

2) Mixture Ratio Shift

3) Guidance Cutoff

4) Orbit Insertion

TABLE 7

S-IVB POWERED FLIGHT TABLES

TIME	MACH	DRAW	ALP	QQQ	VR	TACEL
(SEC)	(U)	(N)	(DEG)	(N/M2)	(M/S)	(M/S2)
1) 148.41	6.52	1144.	1.41	58.	1962.94	6.05
150.00	6.54	1062.	1.59	39.	1963.71	6.34
154.41	6.88	466.	2.97	99.	1978.32	7.39
163.11	7.26	193.	4.41	38.	1997.41	7.48
170.00	7.50	75.	6.18	13.	2020.64	7.82
190.00	6.90	7.	13.67	1.	2096.63	8.09
210.00	5.78	1.	16.00	0.	2187.01	8.46
230.00	4.53	0.	17.64	0.	2291.74	8.81
250.00	4.02	0.	18.67	0.	2410.89	9.16
270.00	3.85	0.	19.42	0.	2544.19	9.63
290.00	3.83	0.	19.75	0.	2692.05	10.05
310.00	4.00	0.	19.77	0.	2855.01	10.60
330.00	4.16	0.	19.57	0.	3032.98	11.11
350.00	4.35	0.	19.02	0.	3227.43	11.78
370.00	4.58	0.	18.35	0.	3439.00	12.46
390.00	4.84	0.	17.48	0.	3668.67	13.25
410.00	5.13	0.	16.31	0.	3919.17	14.15
430.00	5.45	0.	15.09	0.	4191.57	15.17
450.00	5.80	0.	13.69	0.	4488.13	16.41
2) 454.75	5.69	0.	13.34	0.	4563.97	16.72
470.00	6.12	0.	12.03	0.	4762.33	17.59
490.00	6.44	0.	11.11	0.	5032.94	18.52
510.00	6.72	0.	9.44	0.	5325.41	19.58
530.00	7.18	0.	7.46	0.	5643.51	20.82
550.00	7.62	0.	5.81	0.	5990.42	22.27
570.00	8.10	0.	4.35	0.	6370.37	23.98
590.00	8.63	0.	2.39	0.	6789.08	25.95
610.00	9.22	0.	2.40	0.	7254.37	28.58
3) 614.63	9.37	0.	2.69	0.	7369.65	29.24
4) 624.63	9.38	0.	3.26	0.	7376.37	0.00
1) 90% Thrust						
2) Mixture Ratio Shift						
3) Guidance Cutoff						
4) Orbit Insertion						

MARSHALL SPACE FLIGHT CENTER

TABLE 8

ORBITAL FLIGHT LISTING

TIME (SEC)	ALT (M)	RRR (M)	YTH* (DEG)	VVV* (M/S)	AZ* (DEG)
624.63	227951.	6600287.	90.00	7787.41	86.31
830.00	228645.	6601028.	89.94	7787.89	94.84
1030.00	230211.	6603267.	89.89	7785.63	102.68
1230.00	232061.	6606664.	89.85	7782.03	109.44
1430.00	236321.	6611591.	89.81	7777.23	114.75
1630.00	240291.	6617150.	89.78	7771.41	118.53
1830.00	245413.	6623203.	89.77	7764.82	120.81
2030.00	251231.	6629393.	89.77	7757.77	121.64
2230.00	257475.	6635075.	89.79	7750.63	121.06
2430.00	263768.	6640829.	89.81	7742.80	119.06
2630.00	269554.	6645483.	89.85	7737.69	115.59
2830.00	274047.	6649117.	89.89	7732.71	110.63
3030.00	278298.	6651068.	89.93	7729.20	104.24
3230.00	283251.	6652736.	89.98	7727.41	96.70
3430.00	288297.	6652578.	90.03	7727.48	88.57
3630.00	278406.	6651106.	90.08	7729.42	80.56
3830.00	274735.	6648390.	90.12	7733.10	73.27
4030.00	269605.	6644548.	90.16	7738.28	67.46
4230.00	263461.	6639754.	90.19	7744.60	63.02
4430.00	256818.	6634232.	90.21	7751.66	60.07
4630.00	250189.	6628054.	90.23	7759.00	58.57
4830.00	244023.	6622124.	90.22	7766.19	58.50
5030.00	238666.	6616178.	90.21	7772.83	59.84
5230.00	234335.	6610757.	90.19	7778.59	62.65
5430.00	231115.	6606185.	90.15	7783.21	66.99
5630.00	229003.	6602751.	90.10	7786.51	72.55
5830.00	228714.	6602246.	90.09	7786.96	74.09
6030.00	228065.	6600812.	90.03	7794.14	80.07
6230.00	228843.	6601130.	89.95	7794.90	88.18
6430.00	231334.	6603804.	89.87	7792.29	96.46
6630.00	234453.	6607499.	89.81	7788.79	102.59
6830.00	235455.	6608709.	89.79	7787.54	104.13
7030.00	241124.	6615590.	89.73	7780.45	110.61
7230.00	247841.	6623680.	89.68	7771.74	115.62
7430.00	255642.	6632717.	89.60	7761.84	119.09
7630.00	264276.	6642183.	89.65	7751.24	121.08
7830.00	273382.	6651544.	89.66	7740.47	121.64
8030.00	282499.	6660287.	89.69	7730.09	120.80
8230.00	291085.	6667054.	89.74	7720.40	118.53

MARSHALL SPACE FLIGHT CENTER

TABLE 8
ORBITAL FLIGHT LISTING

TIME (SEC)	ALT (M)	RRR (M)	VTH* (DEG)	VVV* (M/S)	(DEG)
8130.00	298559.	6674163.	89.80	7712.79	114.87
8430.00	317993.	6681113.	89.95	7703.39	103.16
8630.00	319132.	6681550.	90.02	7702.51	95.55
8830.00	317618.	6679920.	90.10	7704.23	87.45
9030.00	313515.	6676512.	90.17	7708.78	79.57
9230.00	297101.	6670902.	90.23	7715.60	72.57
9430.00	298851.	6663956.	90.28	7724.27	66.86
9630.00	279363.	6655835.	90.32	7734.57	62.61
9830.00	269342.	6646855.	90.34	7745.58	59.64
10030.00	259453.	6637553.	90.34	7756.75	58.50
10230.00	250323.	6628390.	90.33	7767.44	58.57
1) 10495.00	240224.	6617317.	90.28	7779.86	60.87
10495.00	240224.	6617317.	90.28	7779.86	60.87
10630.00	236180.	6612467.	90.25	7785.10	63.04
10830.00	231705.	6606628.	90.19	7791.19	67.54
11030.00	229186.	6602707.	90.11	7795.06	73.57
11230.00	228289.	6600958.	90.02	7796.58	80.91
11430.00	229225.	6601500.	89.94	7795.71	89.07
11630.00	231784.	6604311.	89.86	7792.53	97.32
11840.00	236101.	6609523.	89.78	7780.89	105.24
12032.00	241398.	6616022.	89.72	7779.92	111.28
12240.00	248452.	6624501.	89.68	7770.76	116.26
12432.00	255999.	6633197.	89.66	7761.21	119.40
12640.00	265015.	6643004.	89.65	7750.18	121.26
12832.00	273761.	6651911.	89.67	7739.88	121.61
13040.00	283194.	6660869.	89.77	7729.18	120.54
13232.00	291343.	6668076.	89.75	7720.29	118.20
13440.00	298949.	6674338.	89.81	7712.29	114.15
13632.00	304313.	6678422.	89.88	7705.86	109.00
13840.00	317832.	6680806.	89.95	7703.48	102.01
14032.00	328662.	6681034.	90.03	7702.89	94.61
14240.00	336806.	6679147.	90.11	7705.06	86.17
14432.00	342632.	6675525.	90.17	7709.56	78.68
14640.00	295765.	6669759.	90.24	7716.84	71.57
14832.00	287719.	6662987.	90.28	7725.39	66.28
15040.00	277807.	6654439.	90.32	7736.07	62.07
15232.00	268203.	6645815.	90.34	7746.64	59.60
15440.00	258019.	6636157.	90.34	7758.19	58.42
15632.00	249394.	6627415.	90.33	7768.34	58.67
15840.00	241395.	6618660.	90.29	7778.16	60.44
16032.00	235559.	6611691.	90.24	7785.59	63.49
16240.00	231099.	6605802.	90.17	7791.80	68.40
16432.00	228745.	6602229.	90.10	7795.31	74.38
16814.80	228928.	6601201.	89.94	7795.83	89.25

- 1) S-IVB/CSM Separation
2) End of Nominal IU Lifetime

MARSHALL SPACE FLIGHT CENTER

TABLE 8

TIME	MASS	THRUST	ORBITAL FLIGHT LISTING VTHE	AZI	VVVE
(SEC)	(KG)	(N)	(DEG)	(DEG)	(M/S)
024.62	30670.74	0.	90.00	86.11	7377.54
830.00	30458.08	0.	89.94	95.11	7378.01
1030.00	30377.70	0.	89.89	103.40	7376.13
1230.00	30319.77	0.	89.84	110.56	7373.18
1430.00	30276.07	0.	89.80	116.23	7369.14
1630.00	30242.05	0.	89.77	120.27	7363.97
1830.00	30213.47	0.	89.76	122.72	7357.73
2030.00	30204.96	0.	89.76	123.61	7350.60
2230.00	30203.17	0.	89.77	122.99	7342.89
2430.00	30201.39	0.	89.80	120.84	7335.08
2630.00	30199.60	0.	89.84	117.13	7327.74
2830.00	30197.81	0.	89.88	111.84	7321.48
3030.00	30196.02	0.	89.93	105.06	7316.88
3230.00	30194.23	0.	89.98	97.08	7314.41
3430.00	30193.28	0.	90.03	88.48	7314.33
3630.00	30192.44	0.	90.08	80.72	7316.69
3830.00	30194.72	0.	90.13	72.41	7321.28
4030.00	30191.99	0.	90.17	66.12	7327.69
4230.00	30099.27	0.	90.20	61.38	7335.36
4430.00	30096.55	0.	90.23	58.22	7343.62
4630.00	30093.83	0.	90.24	56.62	7351.82
4830.00	30091.11	0.	90.24	56.53	7359.40
5030.00	30088.38	0.	90.22	57.98	7365.95
5230.00	30085.66	0.	90.2	61.00	7371.20
5430.00	30082.94	0.	90.16	65.64	7375.06
5630.00	30080.22	0.	90.11	71.87	7377.57
1) 5660.80	30079.72	0.	90.10	73.18	7377.89
5830.00	29323.82	330.	89.3	79.51	7384.55
6030.00	29216.36	81.	89.94	88.08	7384.94
6230.00	29155.68	45.	89.86	96.82	7382.30
2) 6387.80	29123.92	88.	89.79	103.30	7379.02
6430.00	29123.38	1.	89.78	104.93	7377.85
6630.00	29120.82	2.	89.71	111.81	7371.27
6830.00	29118.26	0.	89.66	117.15	7363.12
7030.00	29115.70	0.	89.64	120.88	7353.63
7230.00	29113.14	0.	89.63	123.01	7343.10
7430.00	29110.58	0.	89.64	123.62	7331.96
7600.00	29108.02	0.	89.68	122.73	7320.77
7830.00	29105.46	0.	89.73	120.33	7310.17

- 1) Begin LOX dump
2) End LOX dump

MARSHALL SPACE FLIGHT CENTER

TABLE B
ORBITAL FLIGHT LISTING

TIME (SEC)	MASS (KG)	THRUST (N)	VTHE (DEG)	AZI (DEG)	VVVE (M/S)
8030.00	29102.90	0.	89.79	116.27	7200.51
8430.00	29097.78	0.	89.94	103.92	7289.13
8630.00	29095.22	0.	90.12	95.87	7287.66
8830.00	29092.66	0.	90.10	87.31	7289.50
9030.00	29090.11	0.	90.18	78.97	7294.56
9230.00	29087.56	0.	90.24	71.55	7302.50
9430.00	29085.01	0.	90.23	65.47	7312.72
9630.00	29082.46	0.	90.34	60.94	7324.46
9830.00	29079.91	0.	90.36	57.96	7336.85
10030.00	29077.36	0.	90.36	56.53	7349.04
10230.00	29074.81	0.	90.35	56.61	7360.25
10495.00	29071.43	0.	90.30	59.09	7372.59
10495.00	14212.64	0.	90.30	59.09	7372.59
10630.00	14166.01	0.	90.26	61.41	7377.50
10830.00	14162.98	0.	90.19	66.23	7382.90
11030.00	14159.35	0.	90.11	72.63	7386.02
11230.00	14155.73	0.	90.32	80.40	7386.92
11430.00	14152.10	0.	89.93	89.02	7385.72
11630.00	14148.47	0.	89.35	97.73	7382.56
11640.00	14144.66	0.	89.77	106.10	7377.28
12032.00	14141.17	0.	89.71	112.52	7370.83
12240.00	14137.40	0.	89.66	117.84	7362.25
12432.00	14133.92	0.	89.64	121.21	7353.06
12540.00	14130.14	0.	89.63	123.21	7342.05
12832.00	14126.66	0.	89.65	123.60	7331.34
13040.00	14122.89	0.	89.63	122.45	7319.73
13232.00	14119.40	0.	89.73	119.94	7309.67
13440.00	14115.63	0.	89.80	115.61	7300.23
13632.00	14112.14	0.	89.87	110.12	7293.54
13840.00	14108.37	0.	89.95	102.71	7289.12
14032.00	14104.89	0.	90.03	94.87	7288.04
14240.00	14101.11	0.	90.11	85.95	7290.30
14432.00	14097.63	0.	90.18	78.03	7295.46
14640.00	14093.86	0.	90.25	70.49	7303.97
14832.00	14090.37	0.	90.30	64.85	7313.93
15040.00	14086.60	0.	90.34	60.36	7326.20
15232.00	14083.11	0.	90.36	57.71	7338.05
15440.00	14079.34	0.	90.36	56.44	7350.59
15632.00	14075.86	0.	90.34	56.72	7361.17
15840.00	14072.08	0.	90.31	58.62	7370.94
16032.00	14068.00	0.	90.25	61.90	7378.03
16240.00	14064.83	0.	90.18	67.14	7383.40
16432.00	14061.34	0.	90.10	73.49	7386.20
16814.80	14054.40	0.	89.94	89.31	7385.86

- 1) S-IVB/CSM Separation
2) End of Nominal TV Lifetime

MARSHALL SPACE FLIGHT CENTER

TABLE 8
ORBITAL FLIGHT LISTING

TIME				CX	CY	QZ
(SEC)	(M)	(M)	(M)	(M/S)	(M/S)	(M/S)
624.63	6233099.	148816.	2165667.	-2561.23	410.93	7342.68
830.00	5530759.	228327.	3596126.	-4244.85	359.58	6516.45
1030.00	4536999.	293523.	4788801.	-5646.65	289.35	5252.34
1230.00	3292971.	342993.	5717461.	-6735.97	203.04	3691.71
1430.00	1867468.	373981.	6331338.	-7453.12	105.37	2219.25
1630.00	339152.	384739.	6597244.	-7759.60	1.68	428.22
1830.00	1207922.	374627.	6501338.	-7640.14	-102.38	1262.12
2030.00	2689025.	344144.	6049758.	-7102.29	-201.11	3112.21
2230.00	4023466.	294894.	5268107.	-6180.59	-289.18	4667.80
2430.00	3138985.	229531.	4199855.	-4924.35	-261.83	5965.42
2630.00	5975586.	151455.	2903773.	-3404.29	-415.18	5936.16
2830.00	6488629.	64906.	1450597.	-1703.47	-446.39	7529.53
3030.00	6651028.	-25516.	-50822.	86.38	-453.79	7715.39
3230.00	6454517.	-114989.	-1607761.	1869.63	-436.94	7485.08
3430.00	3909947.	-198726.	-3047922.	3551.48	-296.66	5851.54
3630.00	5046662.	-272221.	-4323692.	5042.57	-234.56	5648.44
3830.00	3910979.	-331486.	-5366139.	6263.21	-254.96	4526.58
4030.00	2563849.	-373057.	-6118609.	7147.35	-160.77	2561.50
4230.00	1077780.	-395174.	-6539768.	7646.05	-57.26	1230.27
4430.00	466892.	-395903.	-6605930.	7730.33	50.10	572.45
4630.00	1986200.	-375058.	-6312520.	7393.23	155.55	3349.04
4830.00	3397107.	-334192.	-5674549.	6650.75	293.36	1002.13
5030.00	4622005.	-274783.	-4726028.	5541.52	338.10	3440.05
5230.00	5593193.	-200142.	-3518273.	4125.09	404.99	5882.25
5430.00	6256690.	-114235.	-2117182.	2478.81	450.20	1264.18
5630.00	6575431.	-21090.	-599633.	693.53	471.04	1741.24
5830.00	6594762.	-4339.	-31423.	357.68	472.10	1764.41
6030.00	6531422.	72032.	951832.	1131.02	466.58	1657.51
6230.00	6126905.	163058.	2451388.	2894.38	426.25	1224.45
6430.00	5384233.	245472.	3815758.	4496.78	381.85	352.35
6630.00	4586098.	501335.	4747204.	5588.73	323.89	419.39
6830.00	4344684.	314043.	4969885.	5849.29	206.41	122.03
7030.00	3066013.	366958.	585721.	6877.11	214.07	1622.48
7230.00	1619095.	399310.	6410309.	7525.29	109.94	938.50
7430.00	83477.	410529.	6619473.	7760.50	-0.27	144.66
7630.00	1456858.	399098.	6468125.	7572.77	-110.55	650.08
7830.00	2918288.	566703.	5965916.	6973.60	-214.94	348.05
8030.00	4222130.	314189.	5141432.	6004.53	-307.86	858.51
8230.00	5298804.	244653.	404035.	4714.53	-384.41	101.95

MARSHALL SPACE FLIGHT CENTER

TABLE 8
ORBITAL FLIGHT LISTING

TIME				CX	CY	CZ
(SEC)	(M)	(M)	(M)	(M/S)	(M/S)	(M/S)
8030.00	-0091380.	161785.	2722749.	-3176.48	440.60	-7014.48
8430.00	-6675592.	-25956.	-270306.	305.56	481.47	-7682.26
8630.00	-6437332.	120924.	-1785845.	2066.32	464.00	-7405.65
8820.00	-5856390.	209913.	-3262239.	3717.41	421.93	-6734.95
9030.00	-4963459.	288187.	-4455801.	5172.48	357.28	-5704.65
9230.00	-3805022.	351531.	-5467595.	6354.61	273.26	-4367.46
9430.00	-2444104.	396476.	-6186879.	7199.95	174.06	-2792.18
9630.00	-951291.	420478.	-6574139.	7661.20	-64.74	-1060.82
9830.00	592864.	422476.	-6606394.	7710.47	49.00	725.07
10030.00	2104960.	400989.	-6282154.	7341.46	161.10	2498.83
10230.00	3542614.	358155.	-5615957.	6570.70	265.45	4132.82
10430.00	5048419.	271712.	-4269487.	5000.48	381.95	5947.74
10630.00	5048419.	271712.	-4269487.	5000.48	381.95	5947.74
10830.00	5657366.	216908.	-3416414.	4701.72	428.32	6664.12
11030.00	6294746.	125916.	-2001960.	2342.17	477.49	7415.48
11230.00	6585365.	-27637.	-477431.	557.28	500.82	7759.47
11430.00	6512717.	72588.	1073261.	-1273.57	496.83	7675.79
11630.00	6080620.	169374.	2564608.	-3027.34	465.58	7168.79
11830.00	5313018.	257117.	3914417.	-4612.92	408.72	6267.17
12030.00	4192660.	334531.	5098413.	-6000.55	324.86	4952.13
12230.00	2944245.	588098.	5912068.	-6950.29	230.77	3488.16
12430.00	1425605.	424022.	6455356.	-7579.20	115.80	1710.87
12630.00	-53315.	435813.	6618651.	-7761.19	3.38	-16.01
12830.00	-1650287.	423784.	6427784.	-7518.80	-118.48	-1875.86
13030.00	-3049093.	390068.	5903345.	-6904.44	-225.04	-3490.52
13230.00	-4374173.	332092.	5012282.	-5855.54	-327.81	-5034.43
13430.00	-1380795.	262154.	3929575.	-4587.36	-406.03	-6196.30
13630.00	-6169962.	170790.	2539527.	-2964.84	-468.26	-7104.22
13830.00	-0382653.	77263.	1124293.	-1316.92	-502.01	-7576.90
14030.00	-6604272.	-28593.	-463852.	535.48	-510.97	-7667.84
14230.00	-6398739.	125398.	-1917456.	2219.07	-493.30	-7259.82
14430.00	-5757405.	223061.	-3379353.	3918.10	-446.97	-6619.42
14630.00	-4869800.	303492.	-4555828.	5290.15	-381.15	-5595.20
14830.00	-3639377.	373476.	-5575839.	6484.14	-288.43	-4174.01
15030.00	-2314744.	419349.	-6233899.	7257.46	-187.32	-2641.19
15230.00	-752492.	445908.	-6596702.	7691.23	-66.64	-829.02
15430.00	730726.	447594.	-6590338.	7694.47	49.30	896.22
15630.00	2294103.	424376.	-6212534.	7263.70	173.04	2719.97
15830.00	3619437.	380774.	-5538711.	6483.23	279.38	4270.44
16030.00	4847516.	311921.	-4495551.	5266.83	379.55	5711.06
16230.00	5727663.	231674.	-3294642.	3860.78	452.92	6745.83
16430.00	6352334.	131343.	-1807548.	2115.06	507.07	7482.09
16630.00	6593532.	-31294.	-337322.	386.38	530.72	7767.62
16830.00	6078053.	169012.	2569930.	-3033.92	498.13	7163.95

- 1) S-IVB/CSM Separation
2) End of Nominal IU Lifetime

MARSHALL SPACE FLIGHT CENTER

TABLE 8
ORBITAL FLIGHT LISTING

TIME (SEC)	XE (M)	YE (M)	ZE (M)	CXE (M/S)	CYE (M/S)	CZE (M/S)
624.63	-50119.	98370.	192758.	-2152.18	544.89	7035.57
830.00	-669121.	218661.	3308897.	-3694.07	621.31	6356.32
1030.00	-1537092.	347509.	4486762.	-5009.15	660.65	5272.54
1230.00	-2650117.	480065.	5440746.	-6074.71	657.25	4126.70
1430.00	-3946819.	607197.	6124008.	-6838.43	605.77	2678.27
1630.00	-5362875.	719027.	6503533.	-7262.54	504.13	1102.21
1830.00	-6828327.	805603.	6561682.	-7330.65	353.95	-521.98
2030.00	-8271141.	857709.	6296949.	-7038.47	160.54	-2113.16
2230.00	-9620825.	867518.	5723868.	-6402.54	-67.27	-3552.80
2430.00	-10611882.	829295.	4673083.	-5459.00	-217.58	-4886.95
2630.00	-11786937.	739934.	3784680.	-4252.54	-576.11	-5529.48
2830.00	-12499382.	599557.	2515889.	-2843.65	-827.02	-6655.60
3030.00	-12915442.	410735.	1128340.	-1301.63	-1053.82	-7122.82
3230.00	-13015606.	180217.	-310016.	302.71	-1240.36	-7202.11
3430.00	-12795408.	-81733.	-1729131.	1890.30	-1371.84	-6531.39
3630.00	-12265554.	-363703.	-3060132.	3386.99	-1435.71	-6324.62
3830.00	-11461423.	-650876.	-4238511.	4721.72	-1422.63	-5411.25
4030.00	-10391953.	-927253.	-5207131.	5830.47	-1227.20	-4235.48
4230.00	-9137932.	-1176202.	-5918942.	6659.19	-1148.63	-2853.64
4430.00	-7749737.	-1381432.	-6339293.	7166.47	-891.15	-1222.76
4630.00	-6294577.	-1528010.	-6447719.	7325.78	-564.10	252.78
4830.00	-4843316.	-1603378.	-6239078.	7127.28	-181.82	1824.72
5030.00	-3407039.	-1598293.	-5723958.	6578.73	236.98	-2304.74
5230.00	-2233502.	-1507623.	-4928263.	5705.54	670.10	4618.69
5430.00	-1203691.	-1330928.	-3891970.	4549.78	1093.04	5700.56
5630.00	-428076.	-1072771.	-2667149.	3166.12	1480.51	6496.12
5830.00	-317101.	-1017063.	-2425946.	2894.56	1545.96	6607.93
6030.00	53394.	-742489.	-1314351.	1631.78	1809.25	6571.05
6230.00	218553.	-354438.	98416.	12.44	2054.66	7092.35
6430.00	58528.	72845.	1501123.	-1606.36	2198.97	6861.67
6630.00	-292361.	423072.	2552524.	-2829.02	2232.67	6436.66
6830.00	-418405.	517788.	2821261.	-3143.38	2229.23	6091.42
7030.00	-1188101.	956732.	3996972.	-4521.94	2138.77	5414.16
7230.00	-2212034.	1365029.	4970020.	-5674.77	1927.38	4277.56
7430.00	-3439231.	1720086.	5694701.	-6546.52	1602.15	2941.45
7630.00	-4809157.	1999503.	6137879.	-7096.62	1176.78	1474.55
7830.00	-6254794.	2185428.	6280736.	-7301.03	670.96	-45.24
8030.00	-7706026.	2264162.	6119403.	-7152.88	109.34	-1554.56
8230.00	-9093077.	2227324.	5664797.	-6662.25	-479.83	-2970.22

MARSHALL SPACE FLIGHT CENTER

TABLE 8
ORBITAL FLIGHT LISTING

TIM	XE	YE	ZE	CXE	CYE	CZE
(SEC)	(M)	(M)	(M)	(M/S)	(M/S)	(M/S)
8030.00	-11349787.	372420.	4941741.	-5855.04	-1066.15	-4229.08
8430.00	-12243282.	429256.	2849607.	-3462.78	-2107.06	-6058.13
8630.00	-12790829.	966431.	1583875.	-1991.00	-2503.78	-6548.05
8830.00	-13333333.	435477.	251438.	-424.18	-2784.71	-6723.26
9030.00	-12958986.	-138441.	108399.	1165.23	-2930.72	-6577.52
9230.00	-12570662.	-726927.	2358701.	2703.37	-2928.77	-6118.91
9430.00	-11885927.	-1299665.	3512142.	4117.57	-2772.65	-5269.62
9630.00	-11936431.	-1825903.	489521.	5340.11	-2464.75	-4365.21
9830.00	-9766706.	-2276369.	3244437.	6310.64	-2014.49	-3152.65
10030.00	-8432304.	-2023424.	5741146.	6979.70	-1440.36	-1793.73
10230.00	-6997339.	-2845678.	5956421.	7311.60	-768.43	-351.11
10495.00	-5060419.	-2920483.	5794055.	7201.17	215.69	1565.81
10495.00	-5060419.	-2920483.	5794055.	7201.17	215.69	1565.81
10630.00	-4116545.	-2856494.	5519322.	6903.67	732.29	2496.12
10830.00	-2792827.	-2634483.	6891372.	6178.94	1481.97	3759.22
11030.00	-1655464.	-2207443.	6028500.	5147.33	2175.68	4829.57
11230.00	-750987.	-1770016.	2975616.	3859.80	2773.47	5654.77
11430.00	-124327.	-1166042.	785596.	2380.86	3239.70	6195.54
11630.00	193547.	-485460.	518007.	784.97	3545.37	6427.78
1184.00	178340.	275914.	627762.	-928.62	3671.16	6231.24
12032.00	-147321.	976890.	2011801.	-2450.17	3600.95	5946.34
12240.00	-817739.	1700760.	3178700.	-3966.65	3325.31	5235.53
12432.00	-1698934.	2330026.	4101641.	-5177.10	2896.77	4344.41
12640.00	-2889503.	2840282.	4886969.	-6219.41	2265.69	3176.69
12832.00	-4152667.	3208948.	5382311.	-6888.81	1557.07	1966.79
13040.00	-5631055.	3444184.	5647891.	-7263.95	691.40	579.28
13232.00	-7031832.	3495786.	5634888.	-7273.25	-158.61	-711.30
13440.00	-8514400.	3365909.	5345768.	-6920.50	-1087.56	-2053.61
13632.00	-9786053.	5077309.	4840761.	-6277.15	-1909.50	-3185.44
13840.00	-10992216.	2594437.	4004958.	-5270.63	-2715.02	-4240.33
14032.00	-11395052.	2010917.	3173152.	-4099.30	-3341.67	-5014.43
14240.00	-12597748.	1259057.	2064362.	-2627.89	-3856.53	-5600.88
14432.00	-12961330.	487197.	957444.	-1144.97	-4153.29	-5887.53
14640.00	-1326617.	-391791.	-274731.	520.88	-4260.03	-5910.05
14832.00	-12779757.	-1212407.	1390006.	2041.98	-4150.25	-5665.63
15040.00	-12191368.	-2033816.	2517200.	3592.01	-3805.57	-5127.20
15232.00	-11376669.	-2717853.	3435209.	4863.50	-3299.60	-4401.29
15440.00	-10242062.	-3327289.	4250460.	5993.75	-2539.94	-3405.13
15632.00	-9011669.	-3736568.	4802492.	6709.80	-1703.32	-2335.66
15840.00	-7545014.	-3986536.	5159201.	7260.40	-685.07	-1071.47
16032.00	-5130093.	-4022917.	5249090.	7370.20	310.91	136.93
16240.00	-4623435.	-3845234.	5085590.	7109.09	1393.15	1426.39
16432.00	-3319244.	-3485474.	4703074.	6527.73	2341.98	2541.62
16814.80	-1103034.	-2273.66.	3361865.	4513.95	3898.77	4356.00

- 1) S-IVB/GSM Separation
2) End of Nominal IU Lifetime

MARSHALL SPACE FLIGHT CENTER

TABLE 8

ORBITAL FLIGHT LISTING

TIME (SEC)	PHIP (DEG)	PHIY (DEG)	PHIR (DEG)	LONG (DEG)	DECL (DEG)	LAT (DEG)
624.63	-125.86	3.36	-3.69	-61.24	31.41	21.58
830.00	-123.12	2.64	-1.98	-45.83	31.27	21.44
1030.00	-126.64	2.13	-2.55	-31.19	29.20	24.36
1230.00	-150.14	1.49	-2.98	-17.42	25.44	25.58
1430.00	-163.61	0.77	-3.24	-4.68	20.34	20.46
1630.00	-177.16	-0.00	-3.33	7.09	14.28	14.36
1830.00	169.52	-0.77	-3.24	18.14	7.59	7.64
2030.00	156.11	-1.50	-2.98	28.91	0.61	0.62
2230.00	142.73	-2.15	-2.55	39.42	-6.38	-6.42
2430.00	129.35	-2.68	-1.98	50.32	-12.10	-12.18
2630.00	115.99	-3.08	-1.31	61.84	-19.25	-19.37
2830.00	102.63	-3.31	-0.56	74.22	-24.51	-24.65
3030.00	89.29	-3.37	0.22	87.59	-28.53	-28.68
3230.00	75.96	-3.24	0.99	101.84	-30.96	-31.12
3430.00	62.63	-2.94	1.71	116.57	-31.58	-31.74
3630.00	49.31	-2.49	2.35	131.20	-30.31	-30.47
3830.00	35.99	-1.90	2.86	145.18	-27.28	-27.43
4030.00	22.67	-1.20	3.22	158.22	-22.79	-22.92
4230.00	9.33	-0.44	3.41	170.29	-17.17	-17.27
4430.00	-4.02	0.36	3.42	-178.43	-10.77	-10.84
4630.00	-17.40	1.14	3.25	-167.66	-3.91	-3.94
4830.00	-31.81	1.86	2.89	-157.05	3.12	3.14
5030.00	-44.26	2.48	2.38	-146.26	10.04	10.10
5230.00	-57.74	2.98	1.74	-134.97	16.55	16.65
5430.00	-71.25	3.31	0.99	-122.86	22.31	22.44
5630.00	-84.78	3.47	0.19	-109.73	26.98	27.13
5830.00	-98.27	3.48	0.14	-107.20	27.68	27.84
6030.00	-111.89	3.43	-0.63	-95.59	30.16	30.32
6230.00	-125.43	3.21	-1.42	-80.72	31.56	31.72
6430.00	-136.10	2.80	-2.13	-65.73	31.01	31.17
6630.00	-148.95	2.37	-2.62	-54.22	29.23	29.39
6830.00	-158.95	2.24	-2.73	-51.23	28.58	28.73
7030.00	-165.87	1.56	-3.18	-37.66	24.52	24.66
7230.00	-179.28	0.79	-3.46	-25.16	19.21	19.33
7430.00	167.36	-0.72	-3.55	-13.58	13.02	13.10
7630.00	154.02	-0.84	-3.45	-2.67	6.28	6.32
7830.00	140.72	-1.61	-3.16	7.90	-0.69	-0.69
	127.43	-2.30	-2.71	18.48	-7.62	-7.66
		-2.86	-2.11	29.39	-14.22	-14.30

MARSHALL SPACE FLIGHT CENTE

TABLE 8

TIME	PHIP	PHIY	ORBITAL FLIGHT LISTING		LONG	DECL	LAT
(SEC)	(DEG)	(DEG)	PHIR	(DEG)	(DEG)	(DEG)	(DEG)
0030.00	114.16	-3.28		-1.39	40.95	-20.20	-20.22
0430.00	87.67	-3.58		3.22	66.80	-25.00	-25.16
0630.00	74.43	-3.45		1.4	81.04	-31.16	-31.22
0830.00	61.20	-3.14		1.80	95.68	-31.51	-31.66
1030.00	49.80	-2.68		2.46	110.14	-30.01	-30.17
1230.00	34.73	-2.34		3.12	123.93	-26.80	-26.55
1430.00	21.48	-1.31		3.41	136.77	-22.18	-22.21
1630.00	8.20	-0.50		3.62	148.67	-16.48	-16.58
1830.00	-17.94	1.56		3.31	159.84	-10.03	-10.10
2030.00	-36.43	2.28		2.86	170.56	-3.16	-3.18
2230.00	-51.84	2.88		2.25	-178.85	3.87	3.89
17495.00	-54.53	2.99		2.11	-164.41	12.91	12.99
17495.00	-54.53	2.99		2.11	-164.41	12.91	12.99
17630.00	-54.53	2.99		2.11	-156.66	17.20	17.30
17830.00	-54.53	2.99		2.11	-144.44	22.87	23.00
11030.00	-54.53	2.99		2.11	-131.19	27.39	27.55
11230.00	-54.53	2.99		2.11	-116.94	30.40	30.56
11430.00	-54.53	2.99		2.11	-102.04	31.59	31.76
11630.00	-54.53	2.99		2.11	-87.07	30.83	31.00
11840.00	-47.03	-2.38		-10.30	-71.96	28.04	28.19
12030.00	10.57	-1.68		-106.39	-59.08	23.96	24.10
12240.00	12.40	-0.83		-176.33	-46.21	18.29	18.40
12432.00	-0.46	-0.00		-176.23	-35.21	12.25	12.33
12640.00	-14.36	0.90		-176.34	-23.92	5.19	5.23
12832.00	-27.15	1.69		-176.63	-13.79	-1.51	-1.52
13040.00	-40.99	2.45		-177.13	-2.76	-8.69	-8.74
13232.00	-53.74	3.72		-177.74	7.78	-14.96	-15.05
13440.00	-67.54	3.49		-178.53	19.92	-21.07	-21.15
13632.00	-80.26	3.74		-179.34	31.99	-25.75	-25.90
13840.00	-94.74	3.80		179.75	46.08	-29.46	-29.62
14032.00	-106.75	3.67		178.92	59.83	-31.30	-31.47
14240.00	-120.52	3.33		178.08	75.07	-31.40	-31.56
14432.00	-133.22	2.84		177.39	88.89	-29.71	-29.87
14640.00	-146.99	2.16		176.79	103.10	-26.15	-26.30
14832.00	-159.72	1.41		176.39	115.30	-21.55	-21.68
15040.00	-173.53	0.52		176.16	127.56	-15.50	-15.59
15232.00	173.70	-0.34		176.14	138.20	-9.23	-9.29
15440.00	159.81	-1.26		176.33	149.31	-2.04	-2.06
15632.00	146.95	-2.04		176.70	159.49	4.70	4.73
15840.00	132.97	-2.78		177.30	170.60	11.81	11.89
16032.00	120.02	-3.33		177.99	-178.19	17.92	18.03
16240.00	105.96	-3.73		178.66	-165.34	23.67	23.81
16432.00	92.95	-3.90		179.73	-152.48	27.84	27.99
16814.80	66.99	-3.66		-178.53	-124.48	31.60	31.76

Manual control begins at 8995 and ends at 9175

S-IVB/CSM Separation
End of Nominal IU Lifetime

TABLE 9
;IB SPENT STAGE REENTRY DATA

TIME (SEC)	ALT (M)	RRR (M)	VTH* (DEG)	VVV* (M/S)	AZ* (DEG)
144.49	61995.	6435263.	63.42.	2325.84	75.70
160.00	76872.	6450118.	66.62	2232.74	75.90
180.00	92831.	6466049.	70.90	2162.25	76.10
200.00	105229.	6478420.	75.44	2106.96	76.30
220.00	114083.	6487247.	80.17	2066.75	76.50
240.00	119401.	6492538.	85.05	2042.31	76.70
260.00	121189.	6494300.	90.00	2034.07	76.90
280.00	119449.	6492535.	94.96	2042.21	77.10
300.00	114179.	6487240.	99.84	2066.55	77.30
320.00	105375.	6478410.	104.57	2106.64	77.51
340.00	93026.	6466036.	109.10	2161.72	77.71
360.00	77122.	6450108.	113.39	2229.96	77.92
380.00	57703.	6430665.	117.38	2295.09	78.15
400.00	35679.	6408618.	120.60	2132.45	78.68
420.00	20304.	6393230.	116.56	902.65	82.85
460.00	11534.	6384456.	110.53	472.12	88.74
480.00	8478.	6381400.	108.46	445.51	89.33
500.00	5854.	6378776.	106.49	430.89	89.68
520.00	3557.	6376479.	104.84	422.07	89.88
540.00	1511.	6374432.	103.49	416.14	90.02
556.17	0.	6372521.	102.59	413.00	90.08

TABLE 9
S-IB SPENT STAGE REENTRY DATA

TIME (SEC)	MASS (K)	THRUST (N)	VTHE (DEG)	AZI (DEG)	RANGE (M)	VVVE (M/S)
144.49	46136.26	197848.	58.28	72.23	61940.	1979.29
160.00	45591.38	0.	61.79	72.41	87395.	1874.59
180.00	45591.38	0.	66.73	72.64	119921.	1790.43
200.00	45591.38	0.	72.09	72.87	152261.	1723.36
220.00	45591.38	0.	77.83	73.11	184466.	1674.03
240.00	45591.38	0.	83.84	73.35	216581.	1643.76
260.00	45591.38	0.	90.00	73.60	248649.	1633.46
280.00	45591.38	0.	96.16	73.86	280713.	1643.47
300.00	45591.38	0.	102.18	74.12	312818.	1673.46
320.00	45591.38	0.	107.92	74.39	345006.	1722.51
340.00	45591.38	0.	113.29	74.66	377322.	1789.21
360.00	45591.38	0.	118.24	74.94	409804.	1871.01
380.00	45591.38	0.	122.75	75.22	442402.	1950.86
400.00	45591.38	0.	127.03	75.50	473817.	1802.64
420.00	45591.38	0.	134.67	75.76	492460.	574.14
460.00	45591.38	0.	166.89	75.40	497648.	169.98
480.00	45591.38	0.	172.46	74.77	498194.	142.30
500.00	45591.38	0.	175.74	75.11	498462.	122.64
520.00	45591.38	0.	177.94	77.42	498587.	108.16
540.00	45591.38	0.	179.65	103.75	498629.	97.09
556.17	45591.38	0.	179.31	236.99	498621.	90.03

MARSHALL SPACE FLIGHT CENTER

TABLE 9
S-IB SPENT STAGE REENTRY DATA

TIME (SEC)	X (M)	Y (M)	Z (M)	DX (M/S)	DY (M/S)	DZ (M/S)
144.49	6434124.	35609.	115707.	1002.54	118.63	2095.32
160.00	6448315.	37445.	147838.	838.32	118.05	2066.01
180.00	6463161.	39157.	189095.	646.70	117.15	2059.95
200.00	6474191.	42131.	230233.	456.40	116.19	2053.65
220.00	6481422.	44444.	271233.	266.78	115.16	2046.23
240.00	6484865.	46737.	312074.	77.63	114.07	2037.64
260.00	6484529.	49007.	352731.	-111.25	112.92	2027.89
280.00	6480416.	51253.	393182.	-300.07	111.70	2016.95
300.00	6472525.	53474.	433401.	-489.01	110.42	2004.82
320.00	6460853.	55669.	473366.	-678.29	109.06	1991.47
340.00	6445391.	57837.	513052.	-868.07	107.64	1976.83
360.00	6426128.	59575.	552427.	-1058.07	106.15	1960.09
380.00	6403114.	62082.	591375.	-1239.17	104.59	1928.98
400.00	6377391.	64159.	628616.	-1261.20	103.13	1916.41
420.00	6359397.	66214.	653514.	-484.39	102.59	754.73
460.00	6348459.	70277.	673358.	-211.11	100.45	410.18
480.00	6344508.	72281.	681361.	-185.20	100.08	392.63
500.00	6341007.	74283.	689127.	-166.03	100.07	384.82
520.00	6337836.	76284.	696780.	-151.83	100.06	380.90
540.00	6334912.	78285.	704373.	-141.01	99.99	378.53
556.17	6332689.	79501.	710484.	-134.22	99.86	377.60

TABLE 9
S-IB SPENT STAGE REENTRY DATA

TIME	XE	YE	ZE	DXE	DYE	DZE
(SEC)	(M)	(M)	(M)	(M/S)	(M/S)	(M/S)
144.45	61692.	-24.	62496.	1025.76	1.09	1692.75
160.00	76267.	-7.	88380.	864.83	2.31	1663.17
180.00	91689.	56.	21580.	677.73	4.02	1657.20
200.00	103385.	154.	54669.	491.93	5.88	1651.65
220.00	111371.	292.	87643.	306.79	7.87	1645.66
240.00	115659.	470.	120492.	122.08	10.00	1639.19
260.00	116256.	693.	153207.	-62.41	12.27	1632.22
280.00	113163.	962.	185778.	-246.88	14.66	1624.76
300.00	106379.	1280.	18194.	-431.53	17.18	1616.78
320.00	95899.	1650.	350446.	-616.56	19.83	1608.27
340.00	81713.	2074.	382521.	-802.16	22.60	1599.16
360.00	63811.	2554.	414404.	-988.04	25.47	1588.65
380.00	42236.	3092.	445990.	-1165.43	28.22	1564.24
400.00	17998.	3664.	475988.	-1188.44	27.31	1355.13
420.00	1250.	4034.	493505.	-433.63	8.61	376.21
460.00	-7898.	4138.	498017.	-168.03	0.13	25.67
480.00	-10987.	4134.	498326.	-142.09	-0.35	7.73
500.00	-13624.	4127.	498390.	-122.64	-0.29	-0.37
520.00	-15924.	4123.	498338.	-108.06	-0.15	-4.49
540.00	-17968.	4121.	498221.	-96.83	-0.03	-6.99
556.17	-19473.	4121.	498097.	-89.68	0.03	-7.99

TABLE 9
S-IB SPENT STAGE REENTRY DATA

TIME (SEC).	CHIP (DEG)	CHIY (DEG)	CHIR (DEG)	LONG (DEG)	DECL (DEG)	LATT (DEG)
144.49	-59.32	0.00	0.00	-79.96	28.53	28.07
160.00	-59.32	0.00	0.00	-79.71	28.60	28.76
180.00	-59.32	0.00	0.00	-79.39	28.69	28.85
200.00	-59.32	0.00	0.00	-79.08	28.78	28.94
220.00	-59.32	0.00	0.00	-78.76	28.86	29.02
240.00	-59.32	0.00	0.00	-78.44	28.94	29.11
260.00	-59.32	0.00	0.00	-78.13	29.03	29.19
280.00	-59.32	0.00	0.00	-77.81	29.11	29.27
300.00	-59.32	0.00	0.00	-77.49	29.19	29.35
320.00	-59.32	0.00	0.00	-77.18	29.27	29.43
340.00	-59.32	0.00	0.00	-76.85	29.34	29.51
360.00	-59.32	0.00	0.00	-76.53	29.42	29.58
380.00	-59.32	0.00	0.00	-76.21	29.50	29.66
400.00	-59.32	0.00	0.00	-75.89	29.57	29.73
420.00	-59.32	0.00	0.00	-75.70	29.61	29.77
460.00	-59.32	0.00	0.00	-75.65	29.62	29.79
480.00	-59.32	0.00	0.00	-75.65	29.62	29.79
500.00	-59.32	0.00	0.00	-75.64	29.62	29.79
520.00	-59.32	0.00	0.00	-75.64	29.62	29.79
540.00	-59.32	0.00	0.00	-75.64	29.62	29.79
556.17	-59.32	0.00	0.00	-75.64	29.62	29.79

TABLE 9
S-IB SPENT STAGE REENTRY DATA

TIME (SEC)	ACH (U)	RAG (N)	ALP (DEG)	QQQ (N/M2)	VR (M/S)	TACEL (M/S2)
144.49	6.36	68809.	0.00	14.	1978.27	2.74
160.00	6.65	7700.	0.00	17.	1873.53	0.17
180.00	6.49	416.	0.00	3.	1789.33	0.01
200.00	5.58	44.	0.00	0.	1722.22	0.00
220.00	4.81	11.	0.00	0.	1672.86	0.00
240.00	4.35	5.	0.00	0.	1642.57	0.00
260.00	4.15	4.	0.00	0.	1632.26	0.00
280.00	4.35	5.	0.00	0.	1642.28	0.00
300.00	4.80	11.	0.00	0.	1672.29	0.00
320.00	5.57	43.	0.00	0.	1721.37	0.00
340.00	6.48	401.	0.00	3.	1788.11	0.01
360.00	6.65	7379.	0.00	54.	1869.95	0.16
380.00	6.11	114016.	0.00	832.	1949.85	2.50
400.00	5.75	1736029.	0.00	12537.	1801.68	38.08
420.00	1.98	2382355.	0.00	14654.	575.74	52.25
460.00	0.56	512519.	0.00	4924.	167.04	11.25
480.00	0.45	495818.	-0.00	4996.	141.34	10.88
500.00	0.38	482844.	-0.00	4940.	122.37	10.59
520.00	0.32	474376.	-0.00	4887.	108.11	10.40
540.00	0.28	468575.	-0.00	4843.	97.09	10.28
556.17	0.26	464032.	-0.00	4796.	90.03	10.18

TABLE 10
COMPLETE AS-205 MISSION STATION LIST

STATION	GEODETIC LATITUDE (Deg. North)	LONGITUDE (Deg. East)	HEIGHT ABOVE ELLIPSOID (Meters)	APPLICABLE FLIGHT PHASE BOOST ORBIT	
<u>ODOP</u>					
Transmitter 1.3.7	28.444373	-80.579973	5.1	X	
<u>GLOTRAC</u>					
Cape Kennedy	28.413386	-80.592263	11.0	X	
Cherry Point, N.C.	34.881507	-76.353404	3.0	X	
Eleuthera	25.268375	-76.313049	31.8	X	
Grand Turk	21.434025	-71.145182	18.6	X	
Bermuda	32.254488	-64.838675	87.1	X	
<u>C-BAND RADAR</u>					
Mila	28.424862	-80.664404	12.0	X	X
Cape Kennedy	28.481767	-80.576514	14.0	X	
Patrick	28.226553	-80.599292	15.0	X	X
Grand Bahama	26.636350	-78.267708	12.0	X	X
Grand Turk	21.462889	-71.132114	28.0	X	X
Bermuda	32.347964	-64.653742	19.0	X	X
Antigua	17.144031	-61.792858	58.0		X
Vanguard Ship	32.700000	-48.000000	0.0		X
Canary Island	27.744861	-15.602000	36.0		X
Ascension	-7.972761	-14.401694	143.0		X
Pretoria	25.943733	28.358489	1626.0		X
Tananarive	19.018056	47.304444	1375.0		X
Carnarvon	24.897403	113.716080	62.0		X
Mercury Ship	25.000000	125.000000	0.0		X
Woomera	30.819728	136.836990	151.0		X
Hawaii	22.122092	-159.665380	1140.0		X
Point Arguello	34.582903	-120.561150	646.0		X
Redstone Ship	25.000000	-118.000000	0.0		X
White Sands	32.358222	-106.369560	232.0		X
<u>TELEMETRY</u>					
New Smyrna Beach	29.066667	-80.916667	0.0	X	
Cape Tel 4	28.463713	-80.653029	0.0	X	X
Mila - CIF	28.542366	-80.643533	0.0	X	X
Vero Beach	27.666667	-80.350000	0.0	X	
Grand Bahama	26.628514	-78.299444	0.0	X	X
Grand Turk	21.446016	-71.147500	0.0	X	X
Bermuda	32.348102	-64.653800	18.0	X	X
Antigua	17.137333	-61.774955	41.2		X
Vanguard Ship	32.700000	-48.000000	0.0		X
Canary Ship	27.742797	-15.598103	35.0		X
Ascension	-79.743140	-14.392221	30.0		X
Tarnanarive	-19.018056	47.304444	1375.0		X
Carnarvon	-24.897356	113.716070	64.0		X
Mercury Ship	25.000000	125.000000	0.0		X
Guam	13.309244	114.734410	127.0		X
Hawaii	22.125267	-159.667620	1142.0		X
Redstone Ship	-25.000000	-118.000000	0.0		X
Guaymas	27.958406	-110.720790	18.0		X
Corpus Christi	27.65540	-97.380256	10.0		X

TABLE 11

AS-205/CSM-101 LAUNCH VEHICLE OPERATIONAL TRAJECTORY, REVISION
PERFORMANCE CHARACTERISTICSS-IB STAGE

Average Longitudinal Sea Level Thrust (lbs)

	<u>H-1 Engine</u>	<u>Turbine</u>	<u>Total</u>
Engine #1	204233.	618.	204851.
Engine #2	199748.	633.	200381.
Engine #3	201948.	594.	202542.
Engine #4	198849.	596.	199455.
Engine #5	200981.	584.	201665.
Engine #6	202797.	622.	203419.
Engine #7	200659.	613.	201272.
Engine #8	202030.	618.	<u>202648.</u>

Total Average Sea Level Thrust (F): 1,616,123.

Flight Time Interval: 0.0 - 140.11 (IECO)

$$\dot{W} = W_t (t = 0) - W_t (t = 140.11) - *W_{aux} / 140.11.$$

$$\dot{W} = 6210.77 \text{ lb/sec} \quad *W_{aux}: \begin{array}{ll} \text{Frost} & = 1100 \text{ lbs} \\ \text{Seal Purge} & = 6 \text{ lbs} \\ \text{Fuel Additive} & = 27 \text{ lbs} \\ \text{Total} & = 1133 \text{ lbs} \end{array}$$

$$I_{SP} = F/\dot{W}$$

$$I_{SP} = 260.21 \text{ (sec)}$$

S-IVB STAGE

High Thrust Level Flight Time Interval: 149.4 - 454.8 seconds

Low Thrust Level Flight Time Interval: 454.8 - 614.8 seconds

AVERAGE VALUES

	<u>High Level Thrust</u>	<u>Low Level Thrust</u>
Vacuum Thrust (lbs)	226019.	176087.
Flowrate (lb/sec)	533.97	407.92
Specific Impulse	423.28	431.67

NOTE: The 0.4% S-IB stage bias is not included in these data.

TABLE 12

AS-205 L/V TRAJECTORY DISPERSION ANALYSIS, REVISION 1
VEHICLE WEIGHT BREAKDOWN
(POUNDS)

Spacecraft*	36,600	
Instrument Unit	4,280	
S-IVB Stage Inert	25,285	
Useable Reserve Propellant	<u>1,452</u>	
Injection Weight		67,617
J-2 Thrust Decay Propellant	<u>140</u>	
S-IVB Cutoff Weight		67,757
S-IVB Propellant Consumed	228,164	
S-IVB APS Propellant Consumed	6	
Ullage Cases (214) and LES (8986)	<u>9,200</u>	
S-IVB "90% Thrust" Weight		305,127
S-IVB GH2 Start Tank	5	
S-IVB Buildup Propellant Consumed	104	
Ullage Propellant Consumed	<u>167</u>	
S-IVB Stage Weight at Separation		305,803
Ullage Propellant Consumed	9	
S-IVB Separation Components	5	
S-IVB Aft Frame Hardware	31	
S-IB/S-IVB Interstage	6,478	
S-IB Dry Weight	84,401	
S-IB Residuals and Reserves	10,949	
S-IVB Frost Consumed	100	
S-IB Frost Consumed	1,000	
S-IB Seal Purge Consumed	6	
S-IB Fuel Additive Consumed	27	
S-IB Gearbox Lubricant Consumed	717	
Inboard Engine Thrust Decay Prpt Consumed	2,152	
Outboard Engine Thrust Decay Prpt Consumed		
To Separation	1,643	
S-IB Mainstage Propellant Consumed	<u>878,460</u>	
Vehicle Liftoff Weight		1,291,78
CSM (9,655 SPS Tanked)	32,758	
SLA	<u>3,842</u>	
	36,600	

TABLE 13

AS-205 L/V TRAJECTORY DISPERSION ANALYSIS
 TRAJECTORY DISPERSION ENVELOPE AT S-IB/S-IVB SEPARATION
 COMBINED S-IB AND S-IVB STAGE THREE SIGMA DEVIATIONS

DISPERSION GROUP		FLIGHT TIME (SEC)	ALTITUDE (M)	SPACE-FIXED VELOCITY (M/S)	SPACE-FIXED FLIGHT PATH ANGLE (DEG)	GROUND RANGE (KM)	SPACE-FIXED FLIGHT AZIMUTH (DEG)	VEHICLE MASS (KG)
S-IB Propulsion	+RSS	3.33	1574.	18.53	1.333	3.19	0.034	1095.
S-IB Propulsion	-RSS	2.68	1406.	19.53	1.212	2.38	0.021	929.
S-IB Non Propulsion	+RSS	0.00	1386.	34.48	1.476	3.70	1.800	141.
S-IB Non Propulsion	-RSS	0.00	1384.	25.54	1.464	2.51	1.798	141.
S-IVB Propulsion	+RSS	0.00	426.	10.34	0.093	0.25	0.012	1046.
S-IVB Propulsion	-RSS	0.00	423.	10.27	0.093	0.25	0.012	1046.
S-IVB Non Propulsion	+RSS	0.00	37.	0.89	0.008	0.02	0.001	91.
S-IVB Non Propulsion	-RSS	0.00	37.	0.89	0.008	0.02	0.001	91.
Combined Positive	RSS	3.33	2140.	40.50	1.991	4.89	1.800	1524.
Combined Negative	RSS	2.68	2018.	33.76	1.903	3.47	1.798	1409.

TABLE 13 (cont'd)

AS-205 L/V TRAJECTORY DISPERSION ANALYSIS
 TRAJECTORY DISPERSION ENVELOPE AT S-IB/S-IVB SEPARATION
 COMBINED S-IB AND S-IVB STAGE THREE SIGMA DEVIATIONS

DISPERSION GROUP		FLIGHT TIME (SEC)	VEHICLE ATTITUDE			(1) VEHICLE ATTITUDE RATE		
			PITCH (DEG)	YAW (DEG)	ROLL (DEG)	PITCH (DEG/S)	YAW (DEG/S)	ROLL (DEG/S)
S-IB Propulsion	+RSS	3.33	0.065	0.006	0.007	---	---	---
S-IB Propulsion	-RSS	2.68	0.042	0.006	0.005	---	---	---
S-IB Non Propulsion	+RSS	0.00	1.020	1.014	1.829	---	---	---
S-IB Non Propulsion	-RSS	0.00	1.013	1.014	1.829	---	---	---
S-IVB Propulsion	+RSS	0.00	0.003	0.000	0.000	---	---	---
S-IVB Propulsion	-RSS	0.00	0.002	0.000	0.000	---	---	---
S-IVB Non Propulsion	+RSS	0.00	0.000	0.000	0.000	---	---	---
S-IVB Non Propulsion	-RSS	0.00	0.000	0.000	0.000	---	---	---
Combined Positive	RSS	3.33	1.022	1.014	1.829	---	---	---
Combined Negative	RSS	2.68	1.014	1.014	1.829	---	---	---

(1) The S-IB stage attitude rates have been omitted in order that more realistic values, reflecting conditions at physical separation, can be determined.

TABLE 13 (cont'd)

AS-205 L/V TRAJECTORY DISPERSION ANALYSIS
 TRAJECTORY DISPERSION ENVELOPE AT S-IB/S-IVB SEPARATION
 COMBINED S-IB AND S-IVB STAGE THREE SIGMA DEVIATIONS

DISPERSION GROUP		FLIGHT TIME (SEC)	SPACE FIXED POSITION VECTOR			SPACE FIXED VELOCITY VECTOR		
			X (M)	Y (M)	Z (M)	XDOT (M/S)	YDOT (M/S)	ZDOT (M/S)
S-IB Propulsion	+RSS	3.33	1613.	410.	4494.	47.03	0.54	28.75
S-IB Propulsion	-RSS	2.68	1468.	318.	3421.	51.47	0.18	27.13
S-IB Non Propulsion	+RSS	0.00	1418.	3003.	3721.	46.27	66.17	51.85
S-IB Non Propulsion	-RSS	0.00	1419.	3086.	2519.	47.46	65.97	46.30
S-IVB Propulsion	+RSS	0.00	421.	1.	260.	7.79	0.02	7.76
S-IVB Propulsion	-RSS	0.00	418.	- 1.	259.	7.72	0.02	7.72
S-IVB Non Propulsion	+RSS	0.00	36.	0.	23.	0.67	0.00	0.67
S-IVB Non Propulsion	-RSS	0.00	36.	0.	23.	0.67	0.00	0.67
Combined Positive		RSS	3.33	2189.	3031.	840.	66.44	59.79
Combined Negative		RSS	2.68	2084.	3102.	249.	65.97	54.22

TABLE 13 (cont'd)

AS-205 L/V TRAJECTORY DISPERSION ANALYSIS
 TRAJECTORY DISPERSION ENVELOPE AT S-IB/S-IVB SEPARATION
 COMBINED S-IB AND S-IVB STAGE THREE SIGMA DEVIATIONS

DISPERSION GROUP		FLIGHT TIME (SEC)	EARTH FIXED POSITION			EARTH FIXED VELOCITY		
			X (M)	Y (M)	Z (M)	XDOT (M/S)	YDOT (M/S)	ZDOT (M/S)
S-IB Propulsion	+RSS	3.33	1586.	24.	3209.	46.41	0.71	28.93
S-IB Propulsion	-RSS	2.68	1427.	8.	2394.	50.70	0.24	27.28
S-IB Non Propulsion	+RSS	0.00	1402.	3003.	3727	45.77	66.17	52.23
S-IB Non Propulsion	-RSS	0.00	1402.	3086.	2528	46.98	65.97	46.74
S-IVB Propulsion	+RSS	0.00	423.	0.	257	7.87	0.00	7.67
S-IVB Propulsion	-RSS	0.00	420.	0.	256	7.81	0.00	7.62
S-IVB Non Propulsion	+RSS	0.00	37.	0.	22.	0.68	0.00	0.66
S-IVB Non Propulsion	-RSS	0.00	37.	0.	22.	0.68	0.00	0.66
Combined Positive	RSS	3.33	2159.	3003.	4925.	65.66	66.17	60.20
Combined Negative	RSS	2.68	2044.	3086.	3491.	69.56	65.97	54.66

TABLE 13 (cont'd)

AS-205 L/V TRAJECTORY DISPERSION ANALYSIS
 TRAJECTORY DISPERSION ENVELOPE AT S-IB/S-IVB SEPARATION
 COMBINED S-IB AND S-IVB STAGE THREE SIGMA DEVIATIONS

DISPERSION GROUP		FLIGHT TIME (SEC)	GEODETIC LATITUDE (DEG)	LONGITUDE POS. WEST (DEG)	EARTH FIXED VELOCITY (M/S)	EARTH FIXED PATH ANGLE (DEG)	EARTH FIXED FLIGHT AZIMUTH (DEG)
S-IB Propulsion	+RSS	3.33	0.009	0.023	19.20	1.562	0.042
S-IB Propulsion	-RSS	2.68	0.006	0.031	20.25	1.414	0.022
S-IB Non Propulsion	+RSS	0.00	0.028	0.026	31.15	1.786	2.225
S-IB Non Propulsion	-RSS	0.00	0.027	0.037	21.41	1.763	2.217
S-IVB Propulsion	+RSS	0.00	0.001	0.002	10.63	0.082	0.001
S-IVB Propulsion	-RSS	0.00	0.001	0.002	10.55	0.082	0.001
S-IVB Non Propulsion	+RSS	0.00	0.000	0.000	0.92	0.007	0.000
S-IVB Non Propulsion	-RSS	0.00	0.000	0.000	0.92	0.007	0.000
Combined Negative	RSS	3.33	0.029	0.035	38.12	2.374	2.225
Combined Negative	RSS	2.68	0.028	0.048	31.31	2.261	2.217

TABLE 14

AS-205 L/V TRAJECTORY DISPERSION ANALYSIS
 TRAJECTORY DISPERSION ENVELOPE AT J-2 ENGINE CUTOFF SIGNAL
 COMBINED S-IB AND S-IVB STAGE THREE SIGMA DEVIATIONS

DISPERSION GROUP		FLIGHT TIME (SEC)	ALTITUDE (M)	SPACE-FIXED VELOCITY (M/S)	SPACE-FIXED FLIGHT PATH ANGLE (DEG)	GROUND RANGE (KM)	SPACE-FIXED FLIGHT AZIMUTH (DEG)	VEHICLE MASS (KG)
S-IB Propulsion	+RSS	4.43	14.	0.00	0.002	7.66	0.050	276.
S-IB Propulsion	-RSS	3.63	0.	0.00	0.001	6.68	0.042	314.
S-IB Non Propulsion	+RSS	1.07	16.	0.00	0.002	12.18	0.065	300.
S-IB Non Propulsion	-RSS	1.56	6.	0.00	0.002	10.28	0.055	207.
S-IVB Propulsion	+RSS	21.52	16.	0.00	0.002	76.91	0.468	408.
S-IVB Propulsion	-RSS	19.33	14.	0.00	0.000	70.00	0.424	436.
S-IVB Non Propulsion	+RSS	0.47	8.	0.00	0.002	2.59	0.015	8.
S-IVB Non Propulsion	-RSS	0.45	6.	0.00	0.002	2.63	0.015	22.
IMU Dispersions	+RSS	0.03	601.	1.60	0.026	0.32	---	---
IMU Dispersions	-RSS	0.03	601.	1.60	0.026	0.32	---	---
Combined Positive	RSS	22.00	602.	1.60	0.026	78.29	0.475	577.
Combined Negative	RSS	19.73	601.	1.60	0.026	71.11	0.430	576.

TABLE 14 (cont'd)

AS-205 L/V TRAJECTORY DISPERSION ANALYSIS
 TRAJECTORY DISPERSION ENVELOPE AT J-2 ENGINE CUTOFF SIGNAL
 COMBINED S-IB AND S-IVB STAGE THREE SIGMA DEVIATIONS

DISPERSION		FLIGHT TIME (SEC)	VEHICLE ATTITUDE			VEHICLE ATTITUDE RATE		
			PITCH (DEG)	YAW (DEG)	*ROLL (DEG)	PITCH (DEG/S)	YAW (DEG/S)	*ROLL (DEG/S)
S-IB Propulsion	+RSS	4.43	1.187	0.035	---	0.002	0.000	---
S-IB Propulsion	-RSS	3.63	1.608	0.041	---	0.000	0.000	---
S-IB Non Propulsion	+RSS	1.07	1.173	1.601	---	0.003	0.002	---
S-IB Non Propulsion	-RSS	1.56	1.469	1.652	---	0.002	0.002	---
S-IVB Propulsion	+RSS	21.52	0.123	0.022	---	0.000	0.000	---
S-IVB Propulsion	-RSS	19.33	0.466	0.027	---	0.001	0.001	---
S-IVB Non Propulsion	+RSS	0.47	0.548	0.540	---	0.002	0.002	---
S-IVB Non Propulsion	-RSS	0.45	0.598	0.540	---	0.002	0.002	---
IMU Dispersions	+RSS	0.03	---	---	---	---	---	---
IMU Dispersions	-RSS	0.03	---	---	---	---	---	---
Combined Positive	RSS	22.00	1.761	1.690	---	0.004	0.003	---
Combined Negative	RSS	19.73	2.306	1.739	---	0.003	0.003	---

* Not Applicable

TABLE 14 (cont'd)

AS-205 L/V TRAJECTORY DISPERSION ANALYSIS
 TRAJECTORY DISPERSION ENVELOPE AT J-2 ENGINE CUTOFF SIGNAL
 COMBINED S-IB AND S-IVB STAGE THREE SIGMA DEVIATIONS

DISPERSION		FLIGHT TIME (SEC)	SPACE FIXED POSITION VECTOR			SPACE FIXED VELOCITY VECTOR		
			X (M)	Y (M)	Z (M)	XDOT (M/S)	YDOT (M/S)	ZDOT (M/S)
S-IB Propulsion	+RSS	4.43	2429.	540.	8993.	8.93	0.20	2.82
S-IB Propulsion	-RSS	3.63	2840.	394.	7658.	10.78	0.24	3.40
S-IB Non Propulsion	+RSS	1.07	3148.	656.	1696.	11.70	0.35	3.68
S-IB Non Propulsion	-RSS	1.56	3698.	558.	9955.	13.84	0.38	4.37
S-IVB Propulsion	+RSS	21.52	25019.	4683	3622.	90.08	2.02	29.43
S-IVB Propulsion	-RSS	19.33	28490.	4279	6313.	98.86	2.29	33.55
S-IVB Non Propulsion	+RSS	0.47	852.	151.	2676.	3.17	0.25	1.00
S-IVB Non Propulsion	-RSS	0.45	842.	151.	2696.	3.16	0.24	1.00
IMU Dispersions	+RSS	0.03	654.	725.	207.	4.10	3.05	0.65
IMU Dispersions	-RSS	0.03	654.	725.	207.	4.10	3.05	0.65
Combined Positive	RSS	22.00	25356.	4817.	84956.	91.42	3.68	29.82
Combined Negative	RSS	19.73	28889.	4396.	77387.	100.54	3.85	34.02

TABLE 14 (cont'd)

AS-205 L/V TRAJECTORY DISPERSION ANALYSIS
 TRAJECTORY DISPERSION ENVELOPE AT J-2 ENGINE CUTOFF SIGNAL
 COMBINED S-IB AND S-IVB STAGE THREE SIGMA DEVIATIONS

DISPERSION GROUP		FLIGHT TIME (SEC)	EARTH FIXED POSITION			EARTH FIXED VELOCITY		
			X (M)	Y (M)	Z (M)	XDOT (M/S)	YDOT (M/S)	ZDOT (M/S)
S-IB Propulsion	+RSS	4.43	1846.	498.	7635.	7.36	1.43	2.10
S-IB Propulsion	-RSS	3.63	2102.	452.	6655.	8.70	1.17	2.50
S-IB Non Propulsion	+RSS	1.07	2827.	998.	12133.	11.41	0.41	3.15
S-IB Non Propulsion	-RSS	1.56	3350.	834.	10235.	13.62	0.41	3.77
S-IVB Propulsion	+RSS	21.52	19943.	5567.	76163.	85.38	7.86	22.88
S-IVB Propulsion	-RSS	19.33	22703.	4983.	69552.	77.80	7.14	26.08
S-IVB Non Propulsion	+RSS	0.47	723.	196.	2578.	2.92	0.30	0.82
S-IVB Non Propulsion	-RSS	0.45	708.	201.	2621.	2.89	0.28	0.81
IMU Dispersions	+RSS	0.03	---	---	---	---	---	---
IMU Dispersions	-RSS	0.03	---	---	---	---	---	---
* Combined Positive	RSS	22.00	20240.	5681.	77543.	86.50	8.01	23.21
* Combined Negative	RSS	19.73	23056.	5076.	70664.	79.51	7.25	26.48

* Does not include effects of IMU dispersions.

TABLE 14 (cont'd)

AS-205 L/V TRAJECTORY DISPERSION ANALYSIS
 TRAJECTORY DISPERSION ENVELOPE AT J-2 ENGINE CUTOFF SIGNAL
 COMBINED S-IB AND S-IVB STAGE THREE SIGMA DEVIATIONS

DISPERSION GROUP		FLIGHT TIME (SEC)	GEODETIC LATITUDE (DEG)	LONGITUDE POS. WEST (DEG)	EARTH FIXED VELOCITY (M/S)	EARTH FIXED PATH ANGLE (DEG)	EARTH FIXED FLIGHT AZIMUTH (DEG)
S-IB Propulsion	+RSS	4.43	0.007	0.070	0.00	0.002	0.052
S-IB Propulsion	-RSS	3.63	0.006	0.080	0.00	0.001	0.045
S-IB Non Propulsion	+RSS	1.07	0.009	0.108	0.00	0.002	0.068
S-IB Non Propulsion	-RSS	1.56	0.008	0.128	0.00	0.002	0.058
S-IVB Propulsion	+RSS	21.52	0.053	0.734	0.02	0.002	0.493
S-IVB Propulsion	-RSS	19.33	0.054	0.808	0.01	0.000	0.448
S-IVB Non Propulsior	+RSS	0.47	0.002	0.028	0.00	0.002	0.016
S-IVB Non Propulsior	-RSS	0.45	0.002	0.027	0.00	0.002	0.016
IMU Dispersions	+RSS	0.03	---	---	---	---	---
IMU Dispersions	-RSS	0.03	---	---	---	---	---
* Combined Positive	RSS	22.00	0.054	0.746	0.02	0.004	0.501
* Combined Negative	RSS	19.73	0.055	0.822	0.01	0.003	0.454

* Does not include effects of IMU dispersions.

FIGURE 1

S-IB STAGE ALTITUDE VS GROUND RANGE

371030
001 001

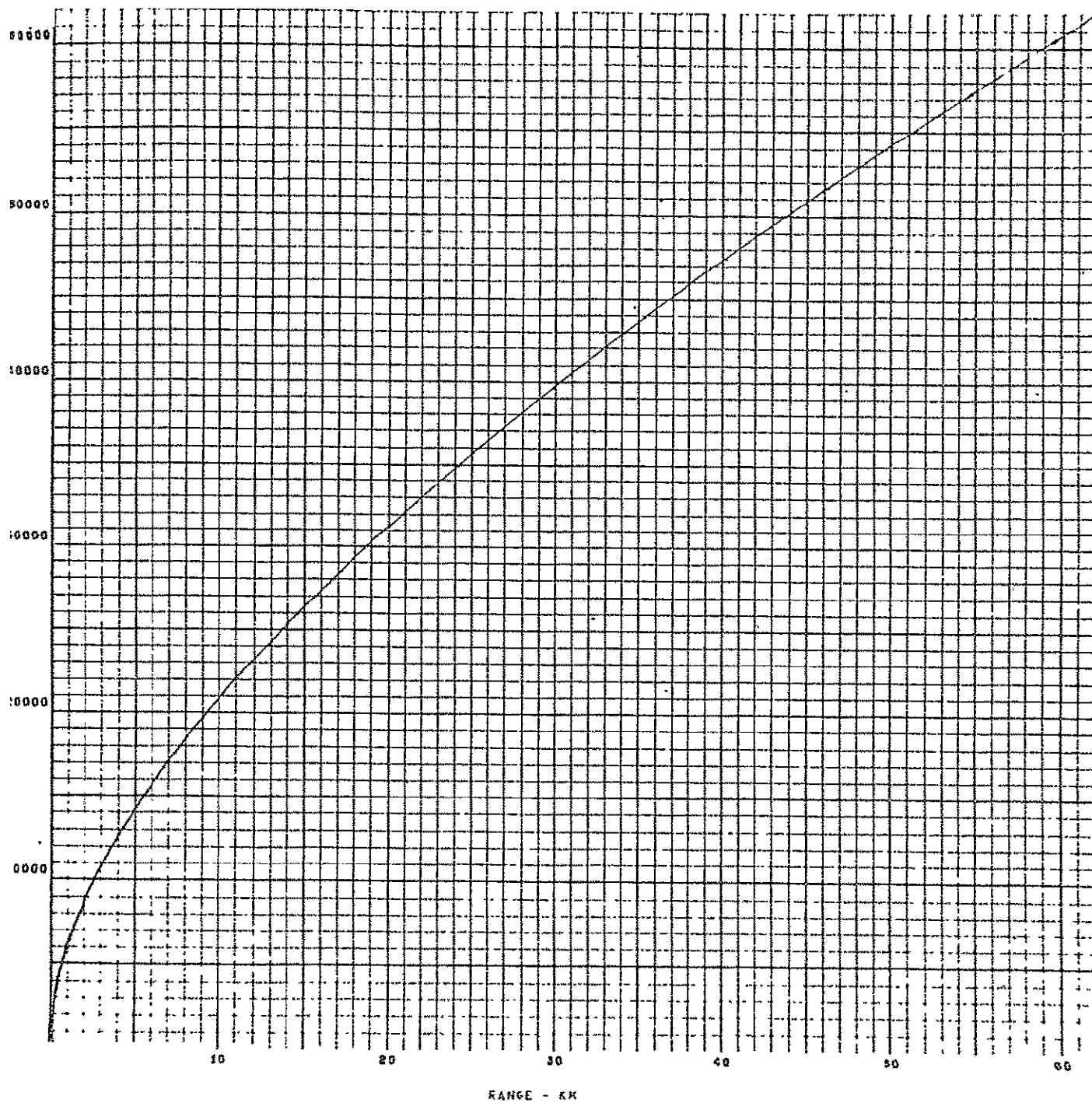


FIGURE 2
S-IB STAGE SPACE FIXED VELOCITY VS TIME

3/16/50
006

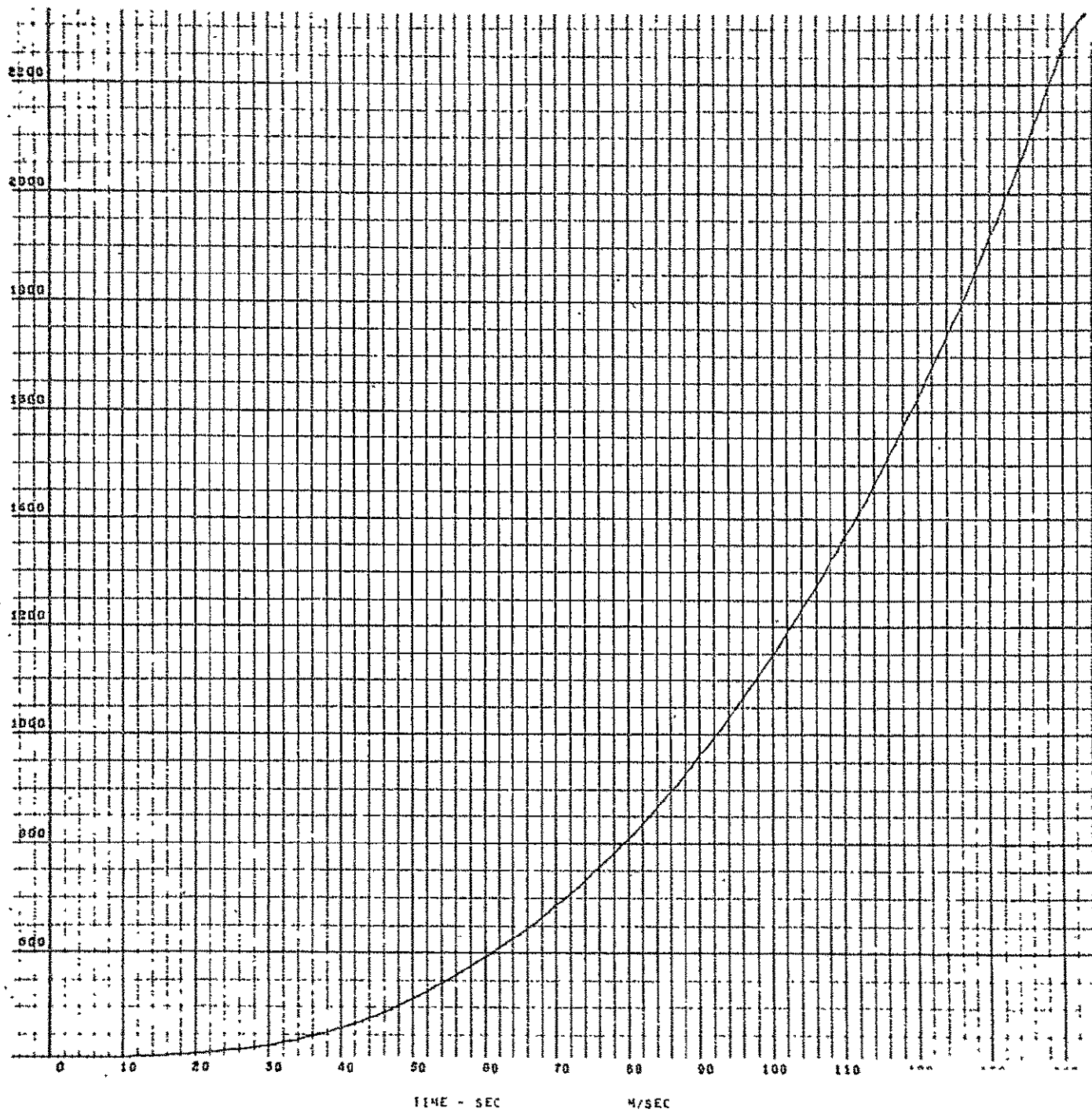


FIGURE 3

S-TB STAGE SPACE FIXED PATH ANGLE VS TIME

371830
009 000

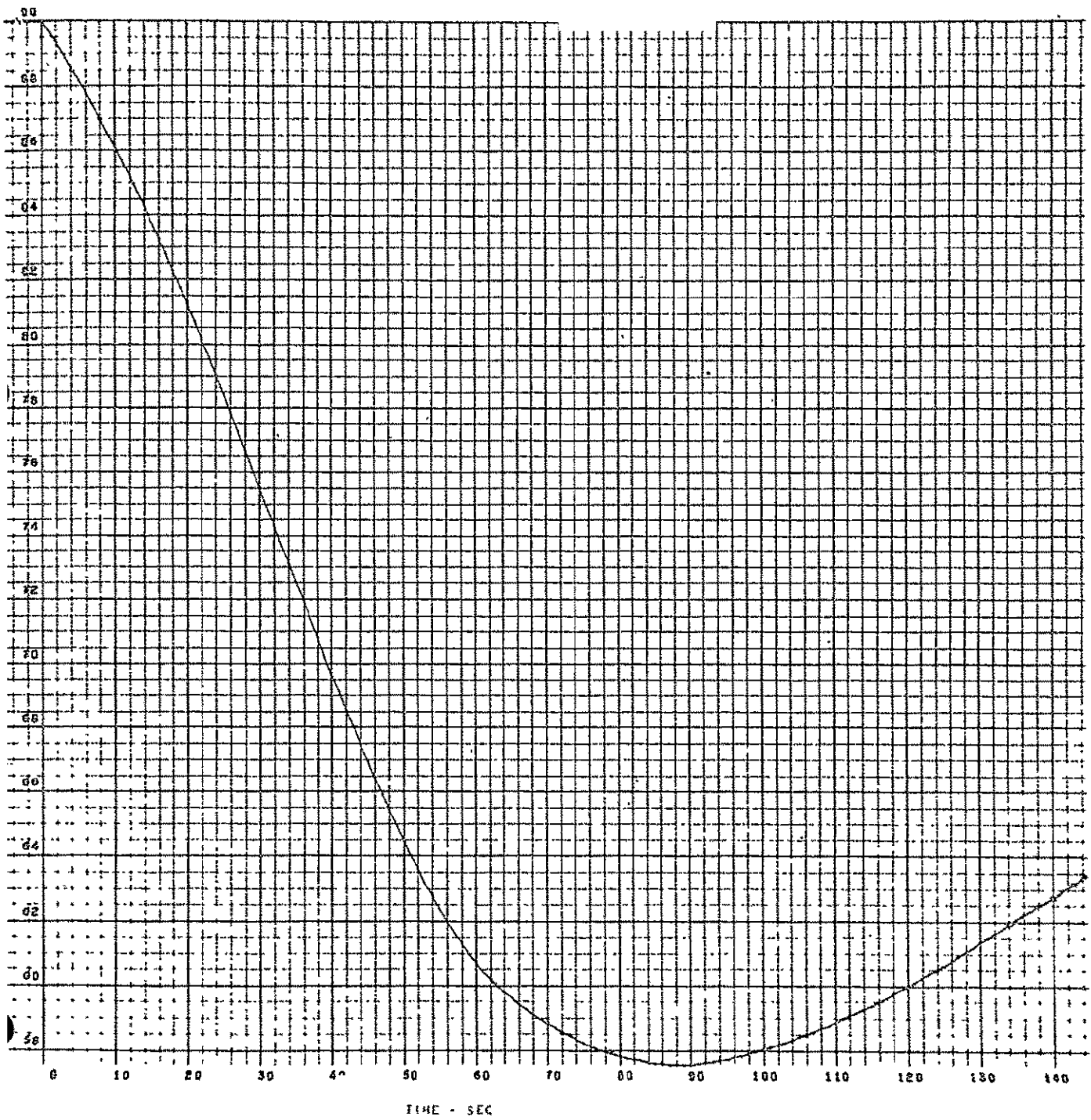


FIGURE 4

S-IB STAGE LONGITUDINAL ACCELERATION VS TIME

371830
002 002

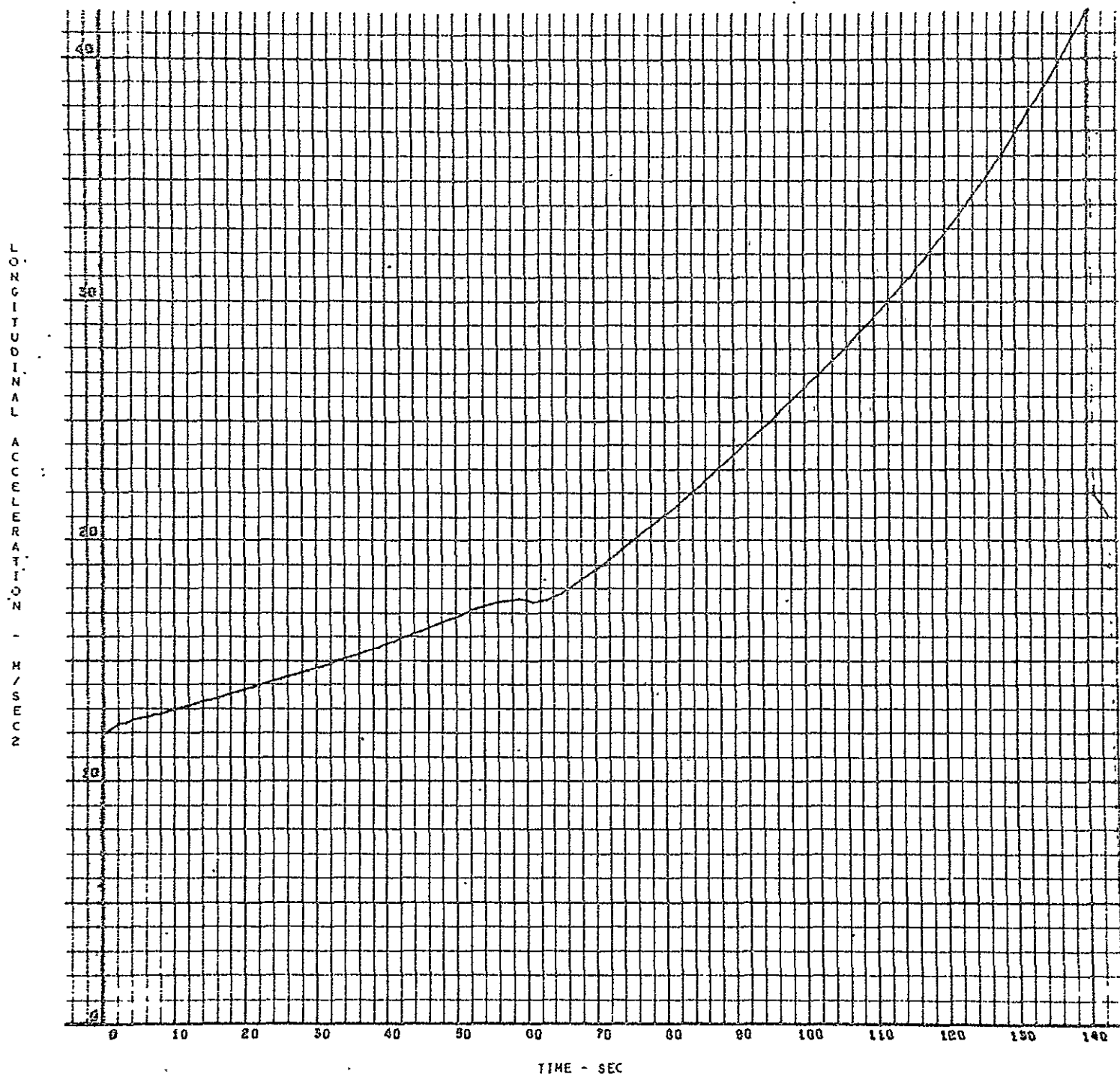


FIGURE 5

S-IB STAGE DYNAMIC PRESSURE VS TIME

371630
005 0

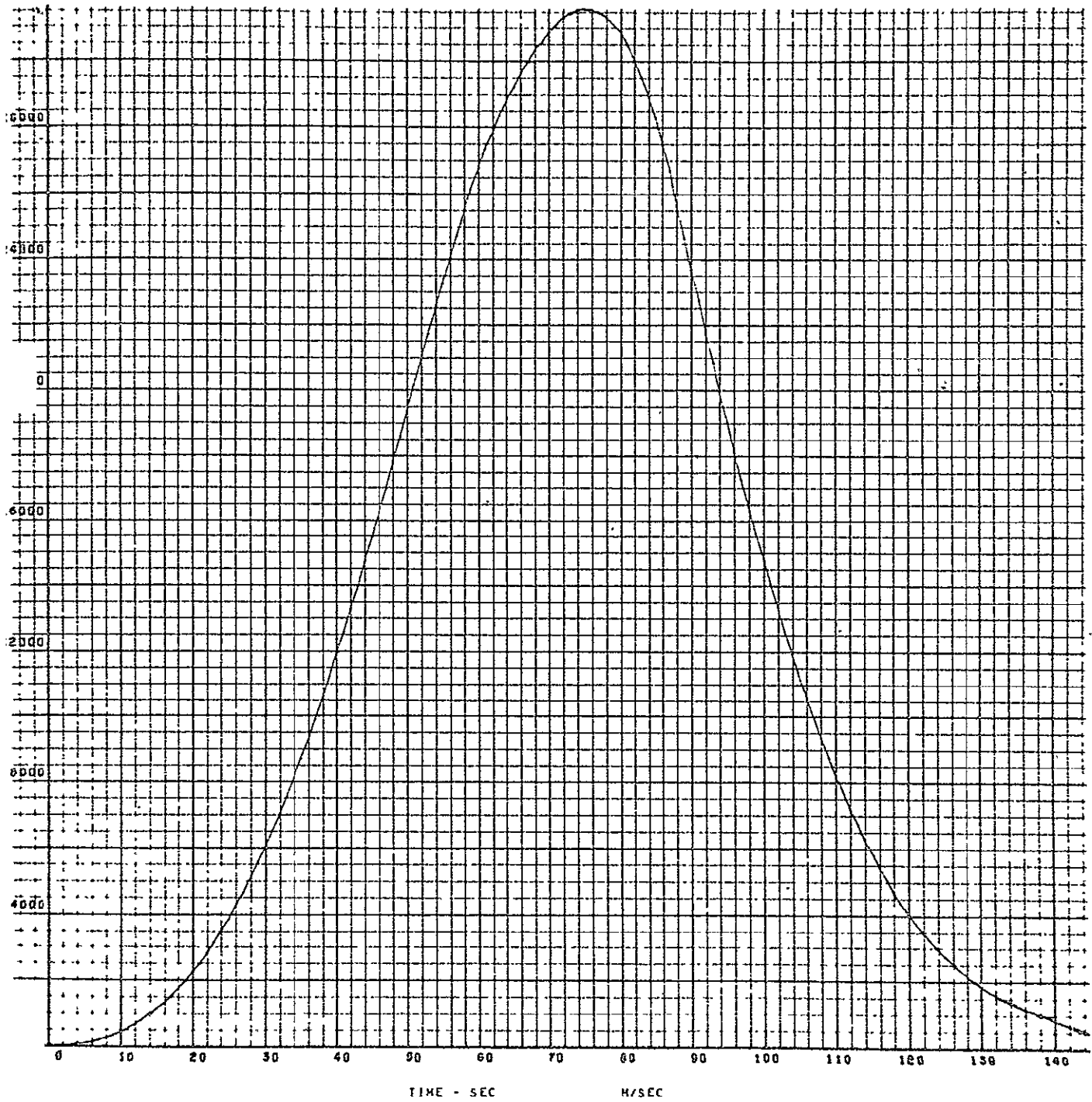
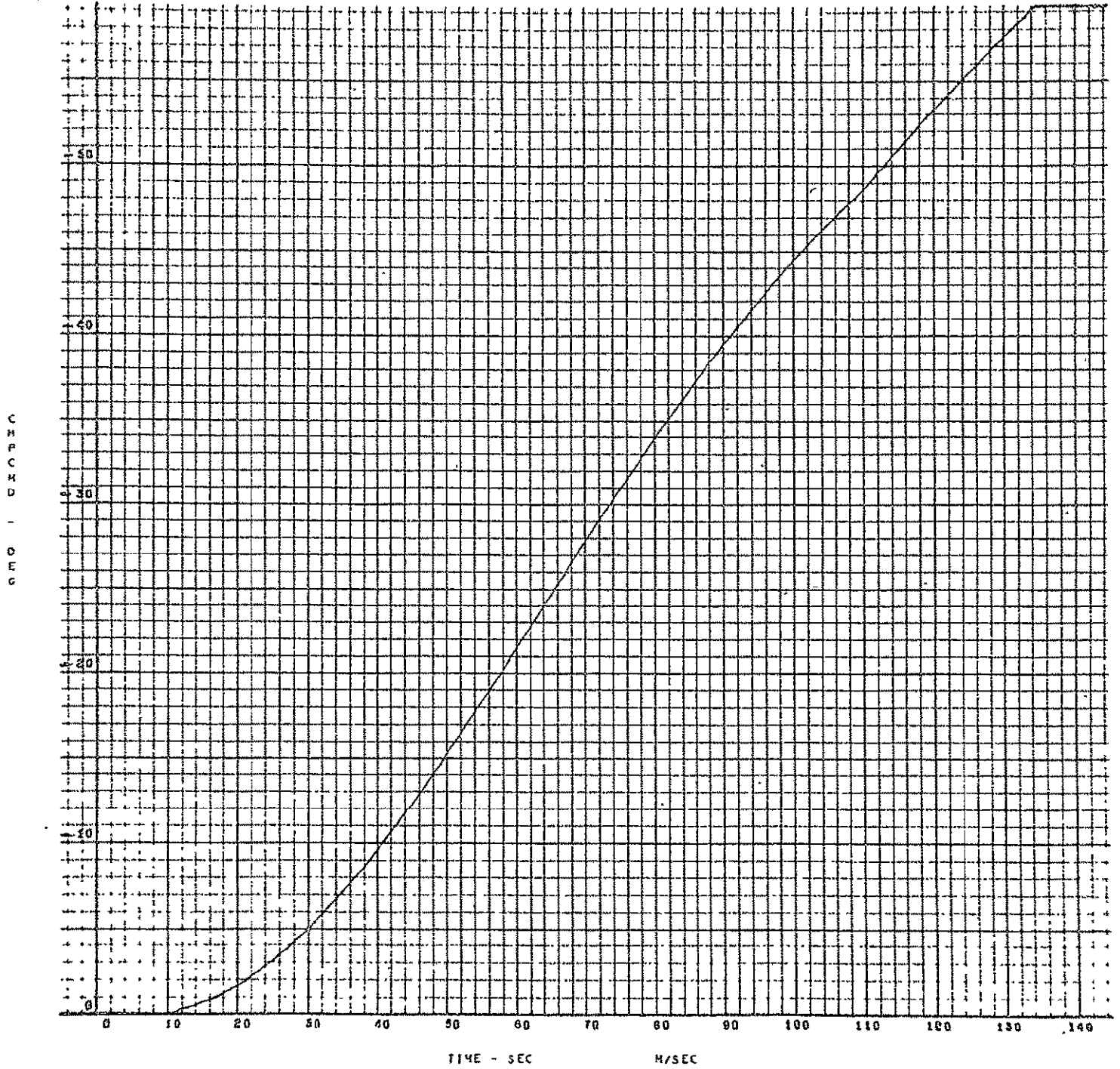


FIGURE 6
S-IB STAGE PITCH ATTITUDE COMMANDS VS TIME

371835
008 00



3-IB STAGE PITCH ANGLE OF ATTACK VS TIME

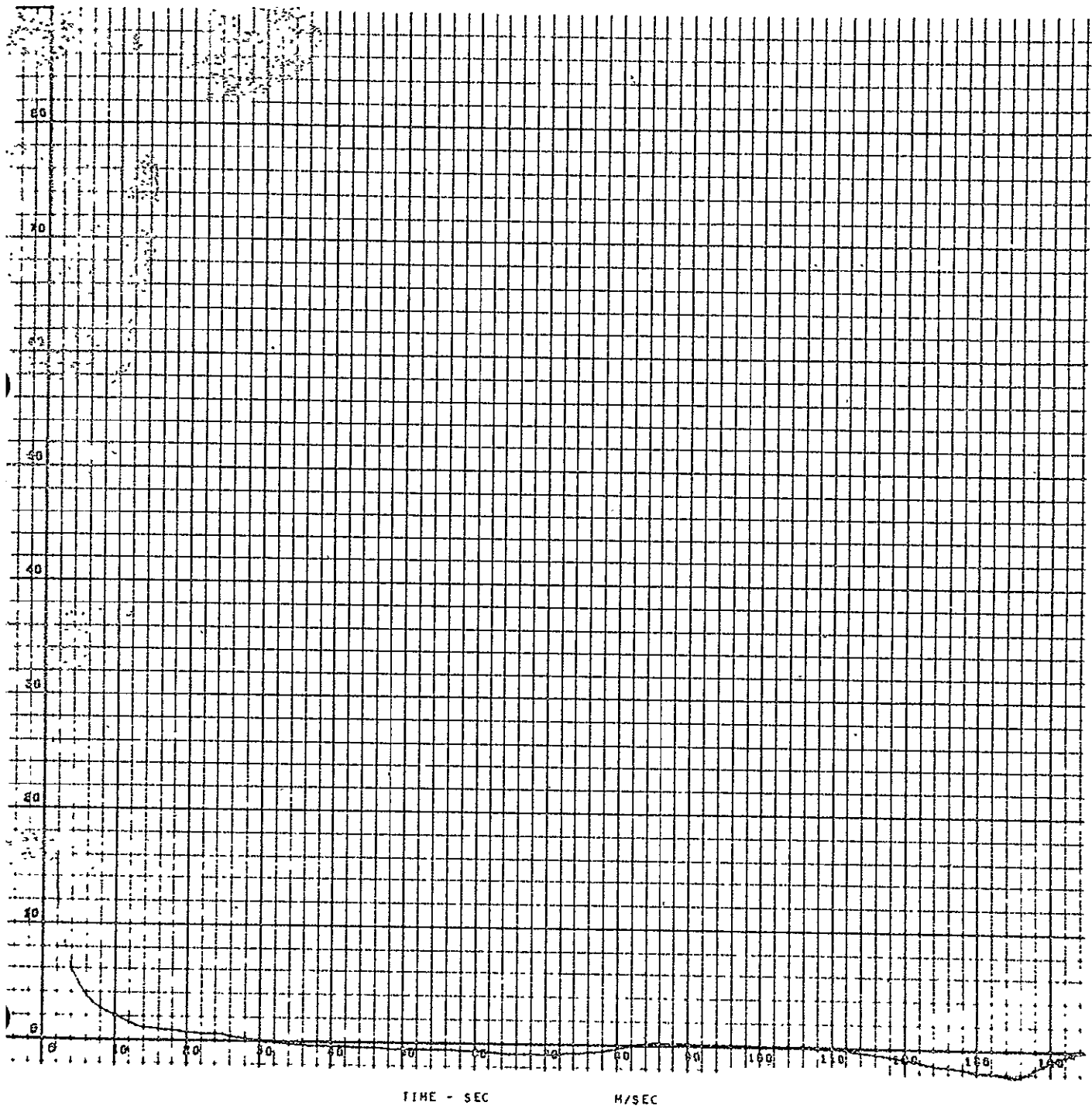
371030
031

FIGURE 8
S-IVB STAGE ALTITUDE VS GROUND RANGE

371838
002 00.

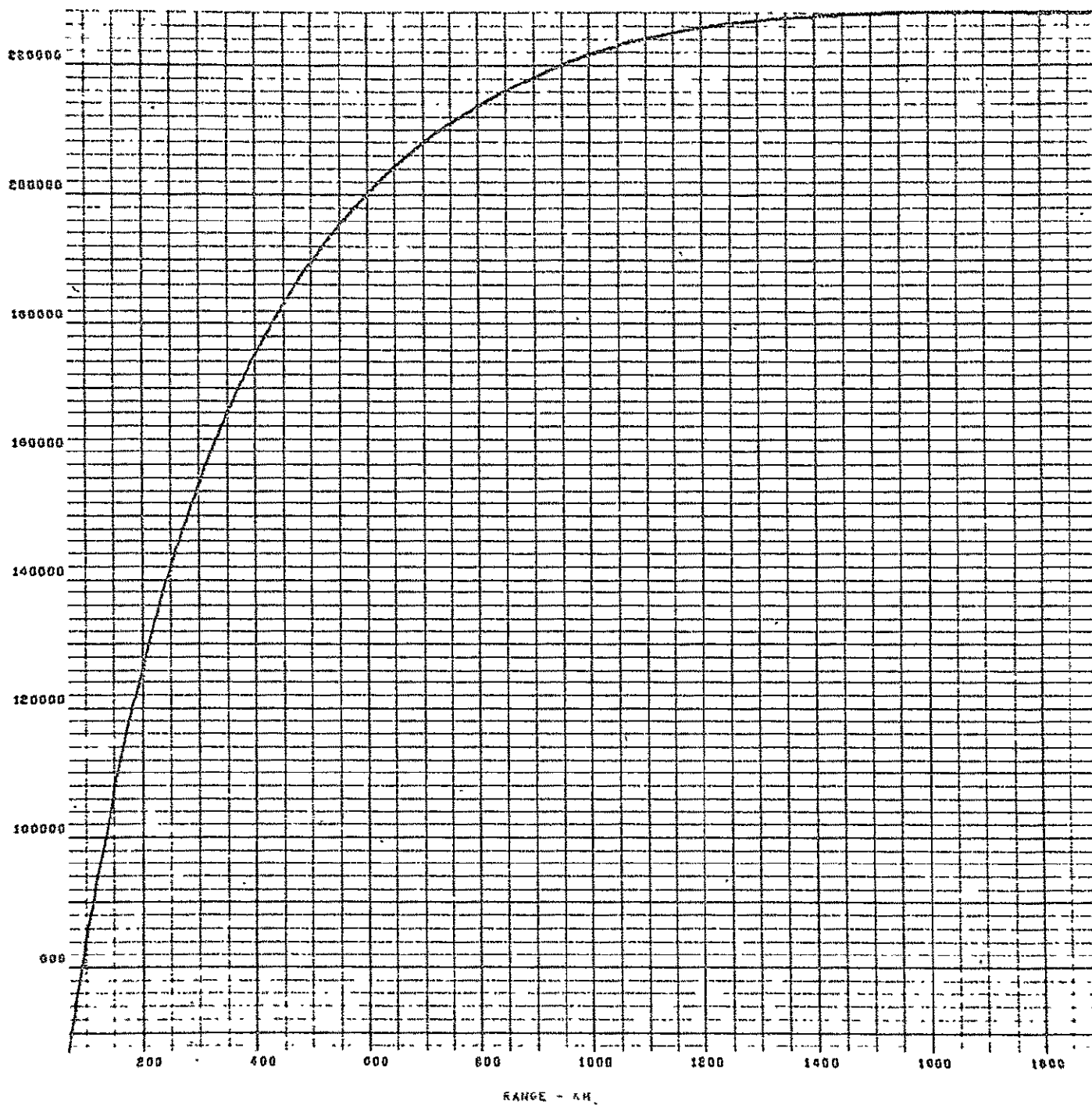


FIGURE 9

S-IVB STAGE SPACE FIXED VELOCITY VS TIME

371836
018 016

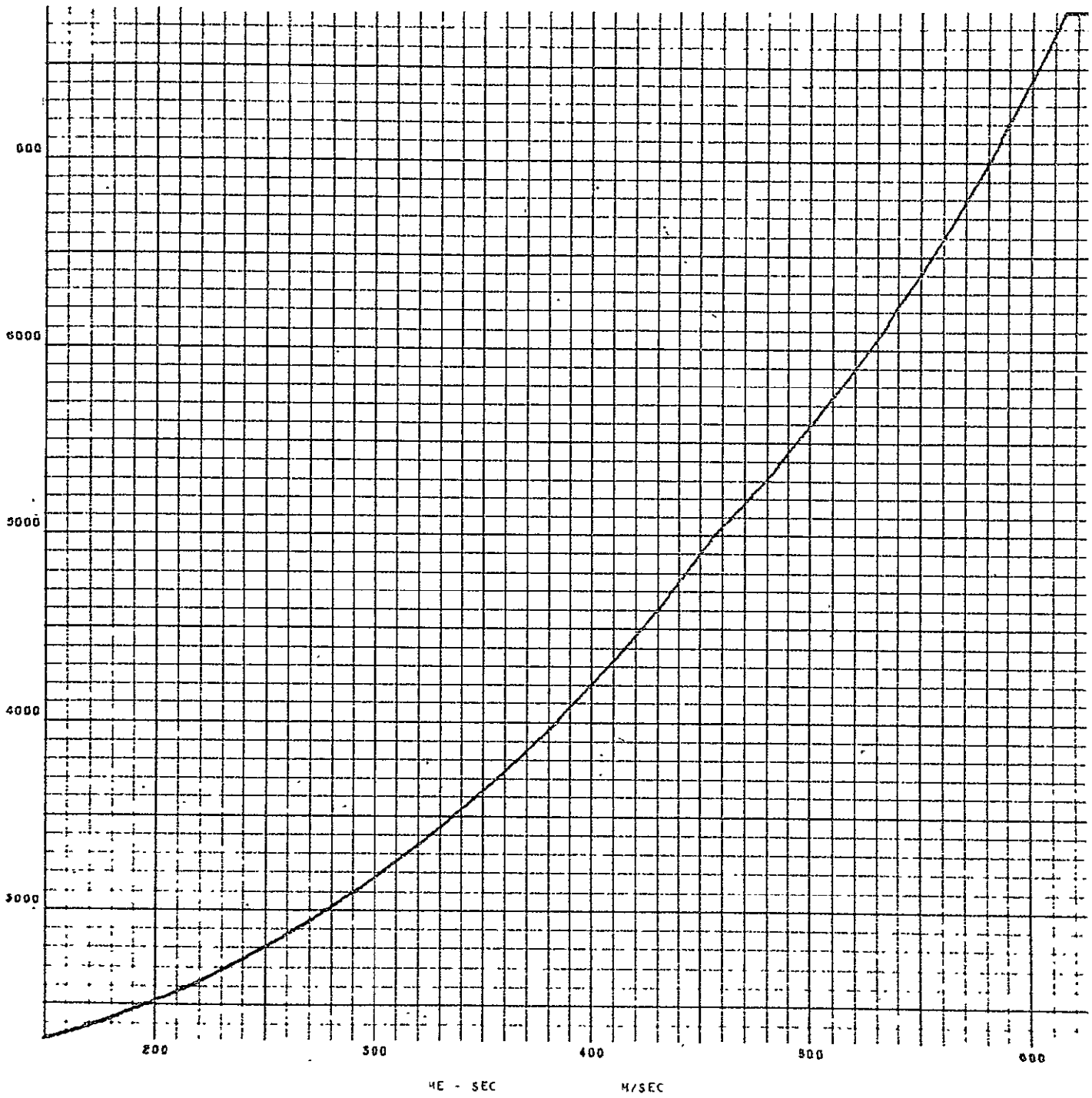


FIGURE 10
S-IVB STAGE SPACE FIXED PATH ANGLE VS TIME

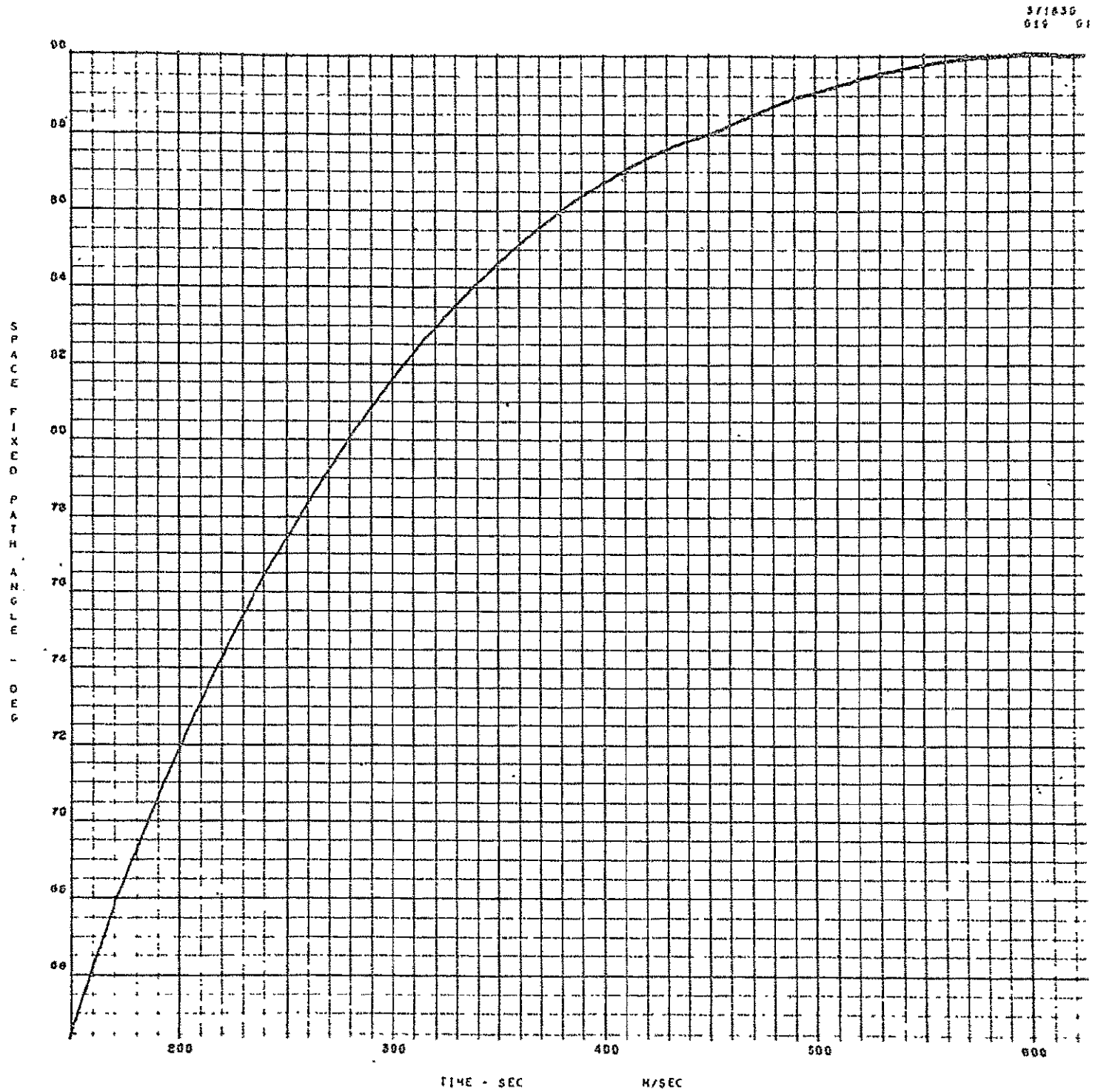
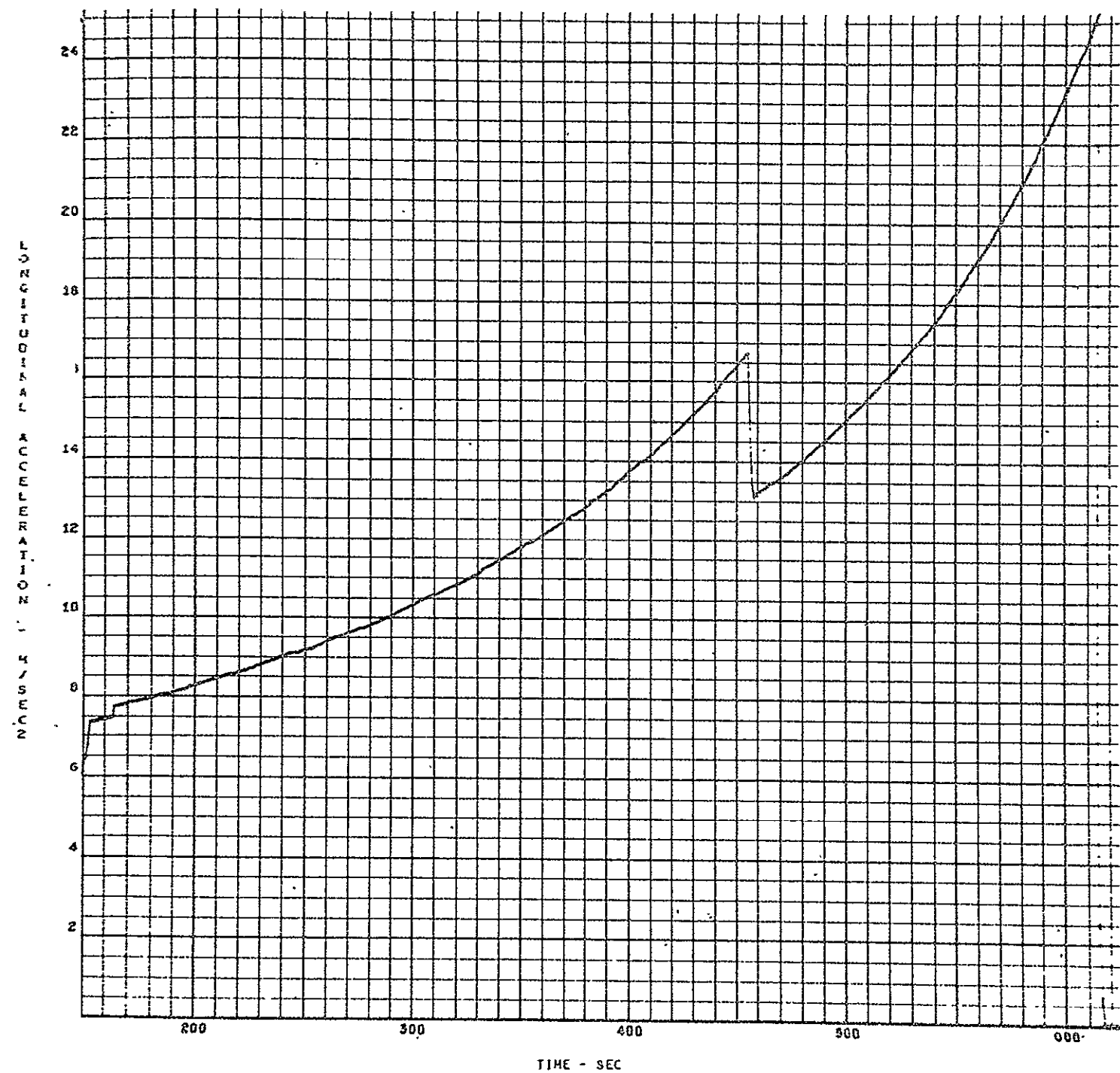


FIGURE 11.

S-IVB STAGE LONGITUDINAL ACCELERATION VS TIME

371830 L
004 054



TIME - SEC

FIGURE 12
S-IVB STAGE PITCH ATTITUDE COMMAND VS TIME

371#36 1
016 010

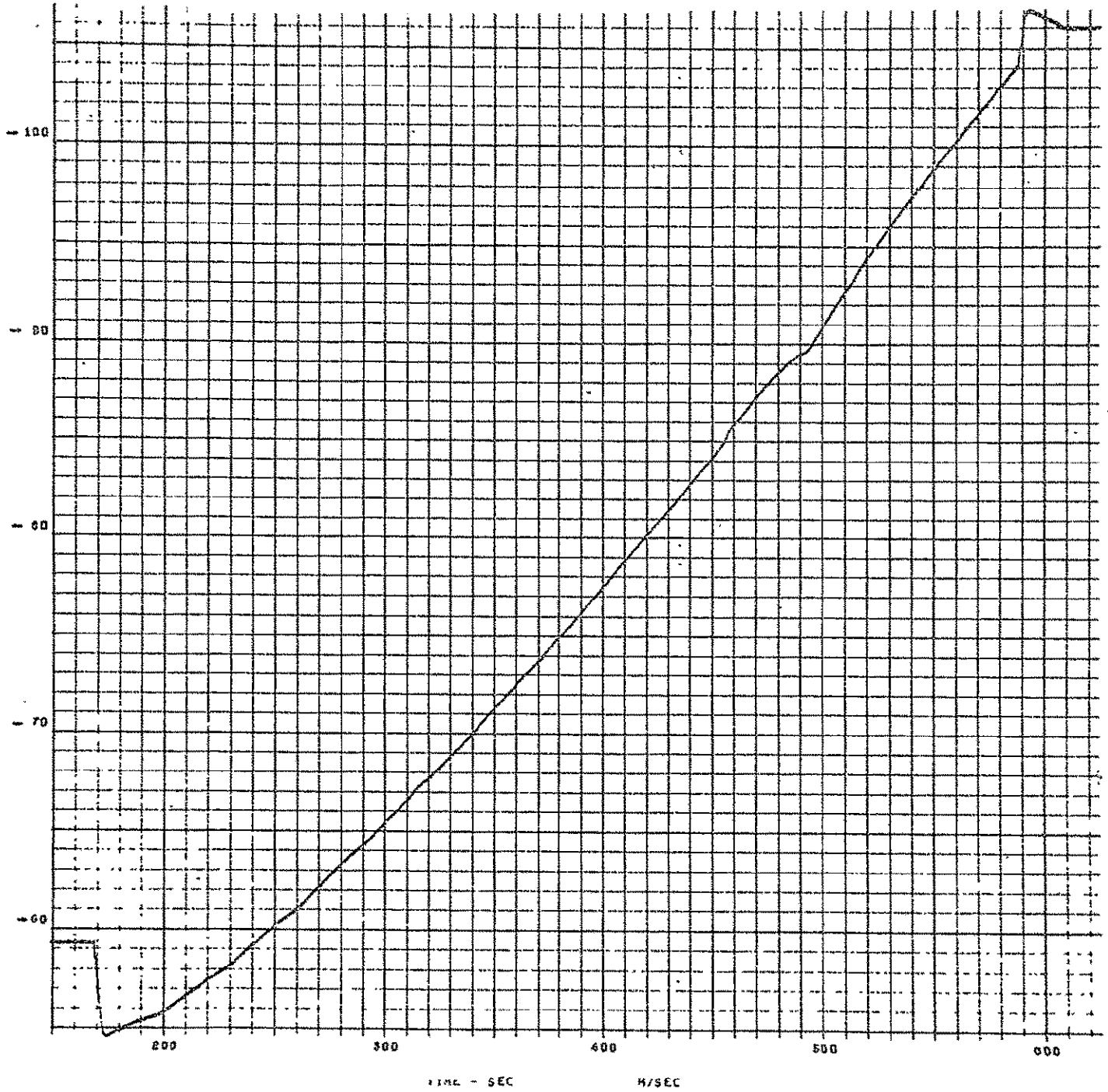


FIGURE 13

S-IVB STAGE YAW ATTITUDE COMMANDS VS TIME

371030
G17 017

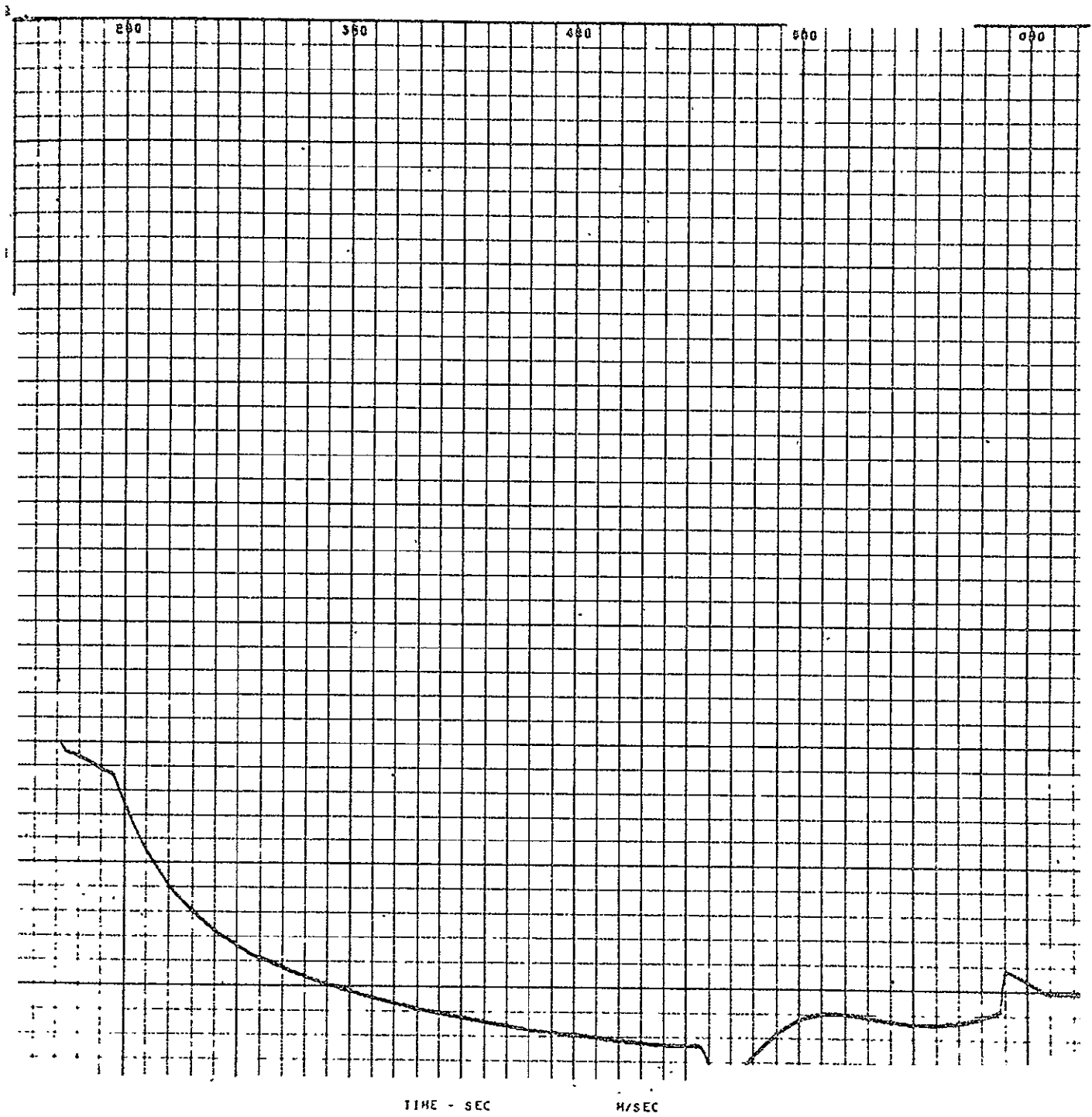


FIGURE 14

S-IVB STAGE SPACE FIXED PATH ANGLE VS SPACE FIXED VELOCITY

371036
004 01

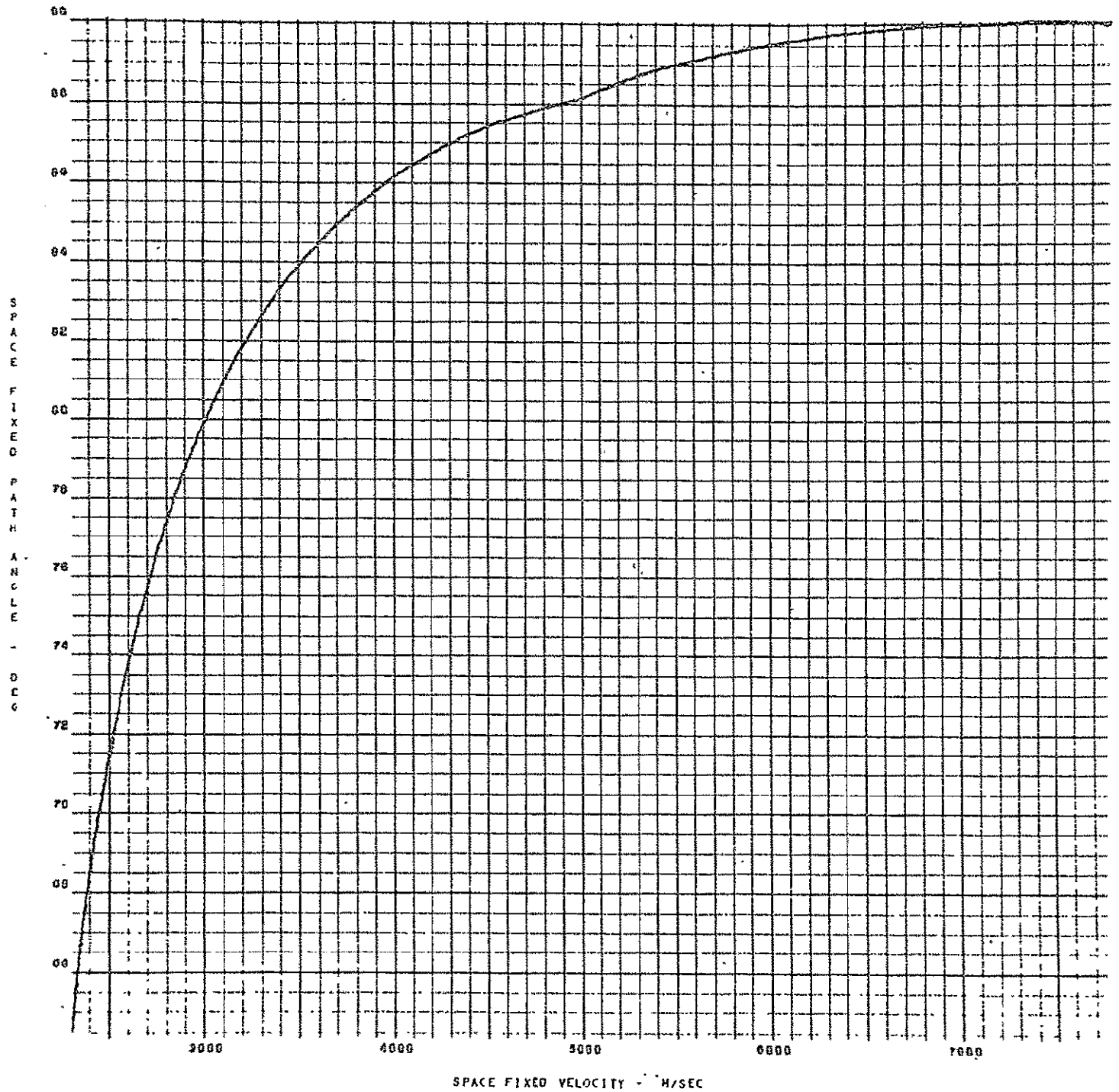


FIGURE 15
S-IVB STAGE THRUST VS TIME

371050 L
005 005

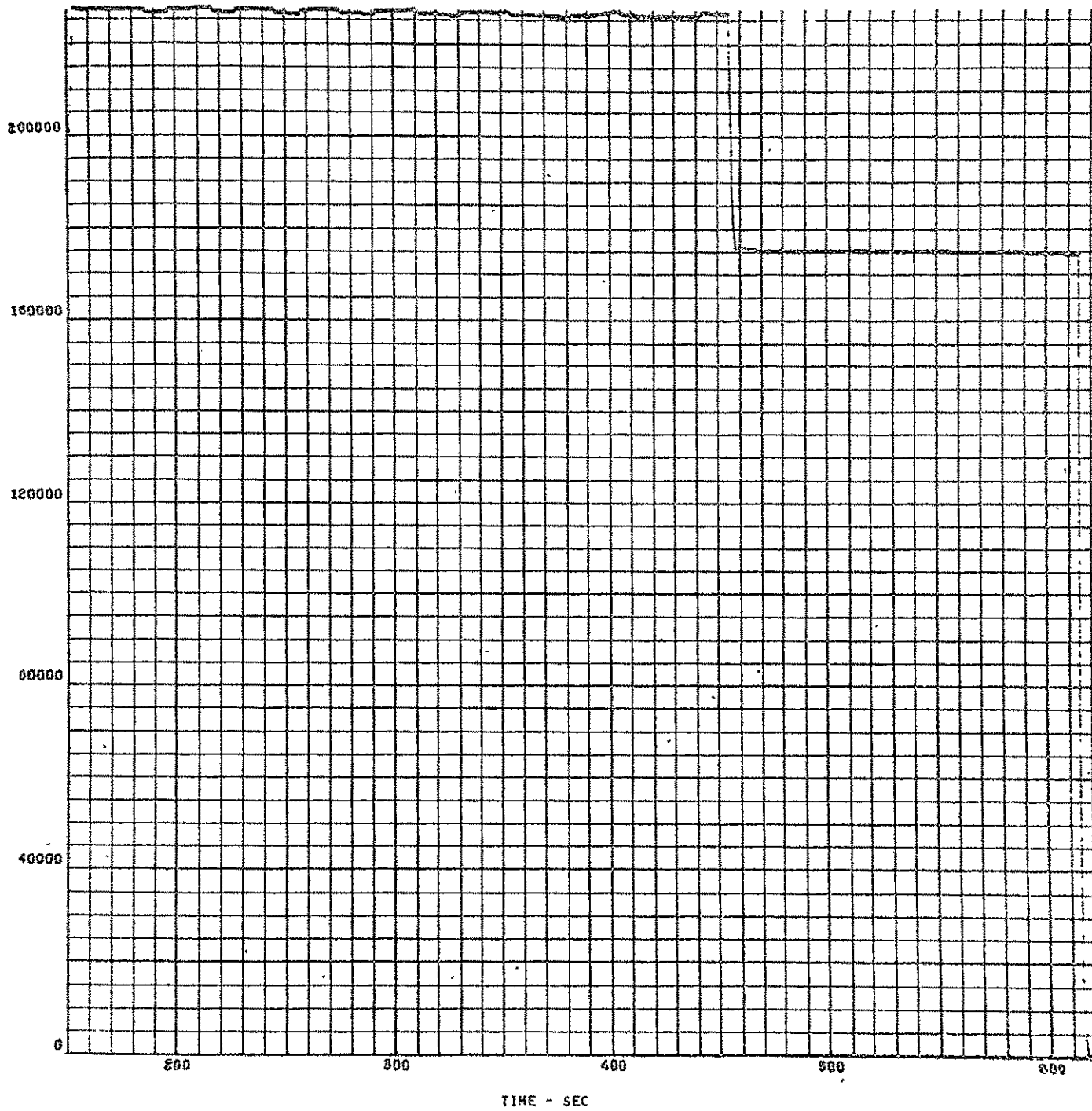
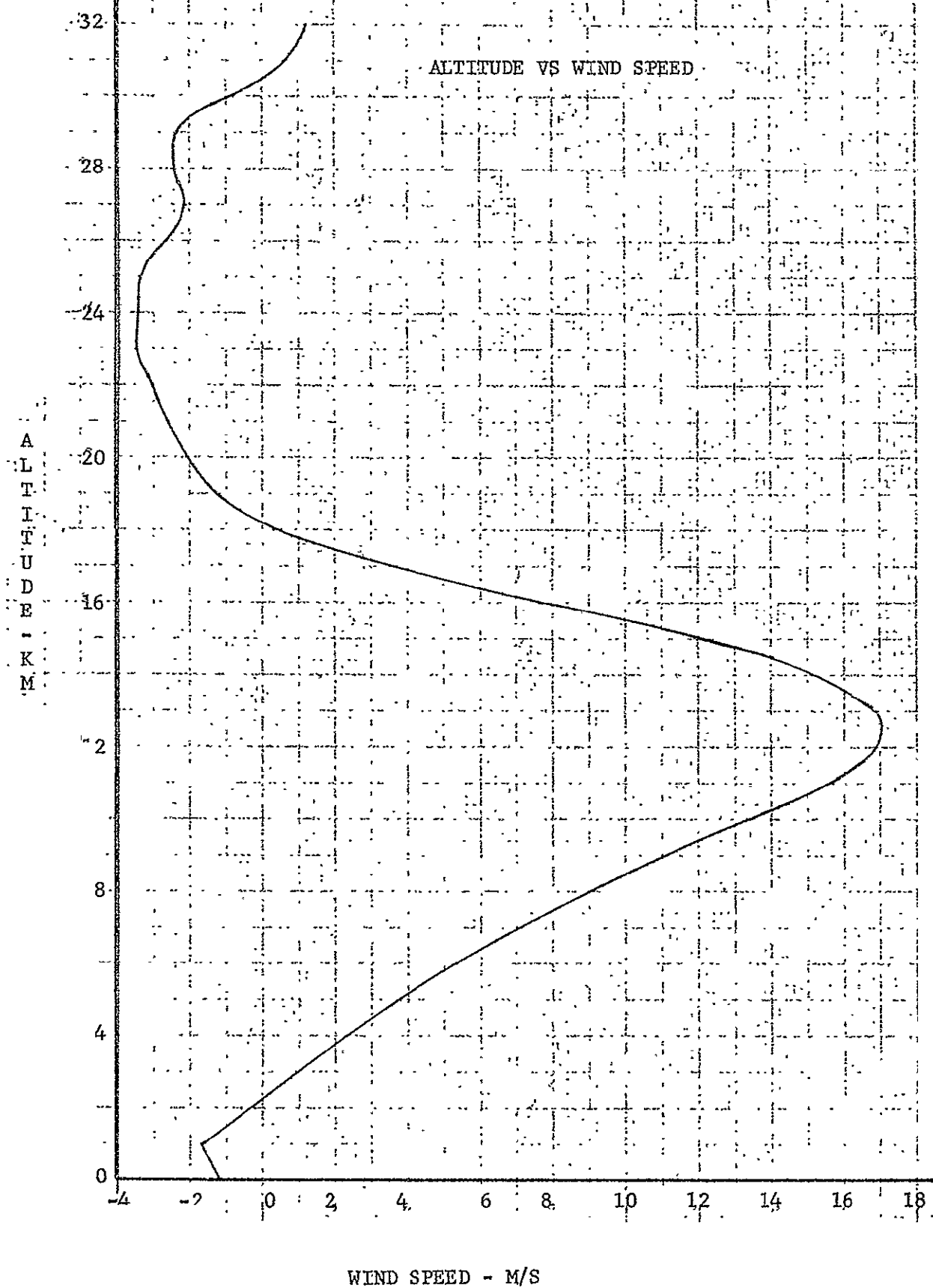


FIGURE 16
OCTOBER MEDIAN WIND PROFILE



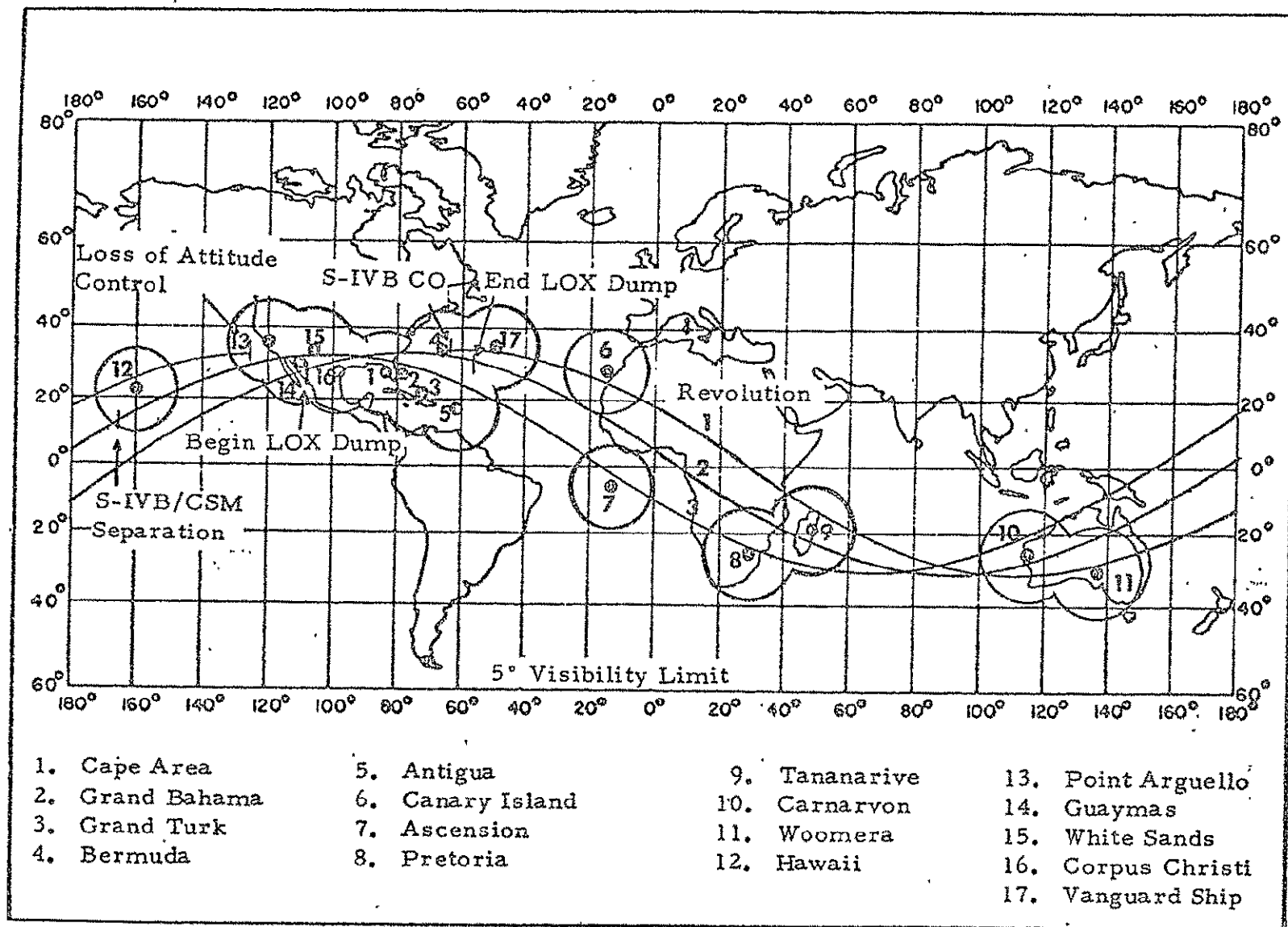


FIGURE 17. SA-205 ORBITAL GROUND PROJECTION

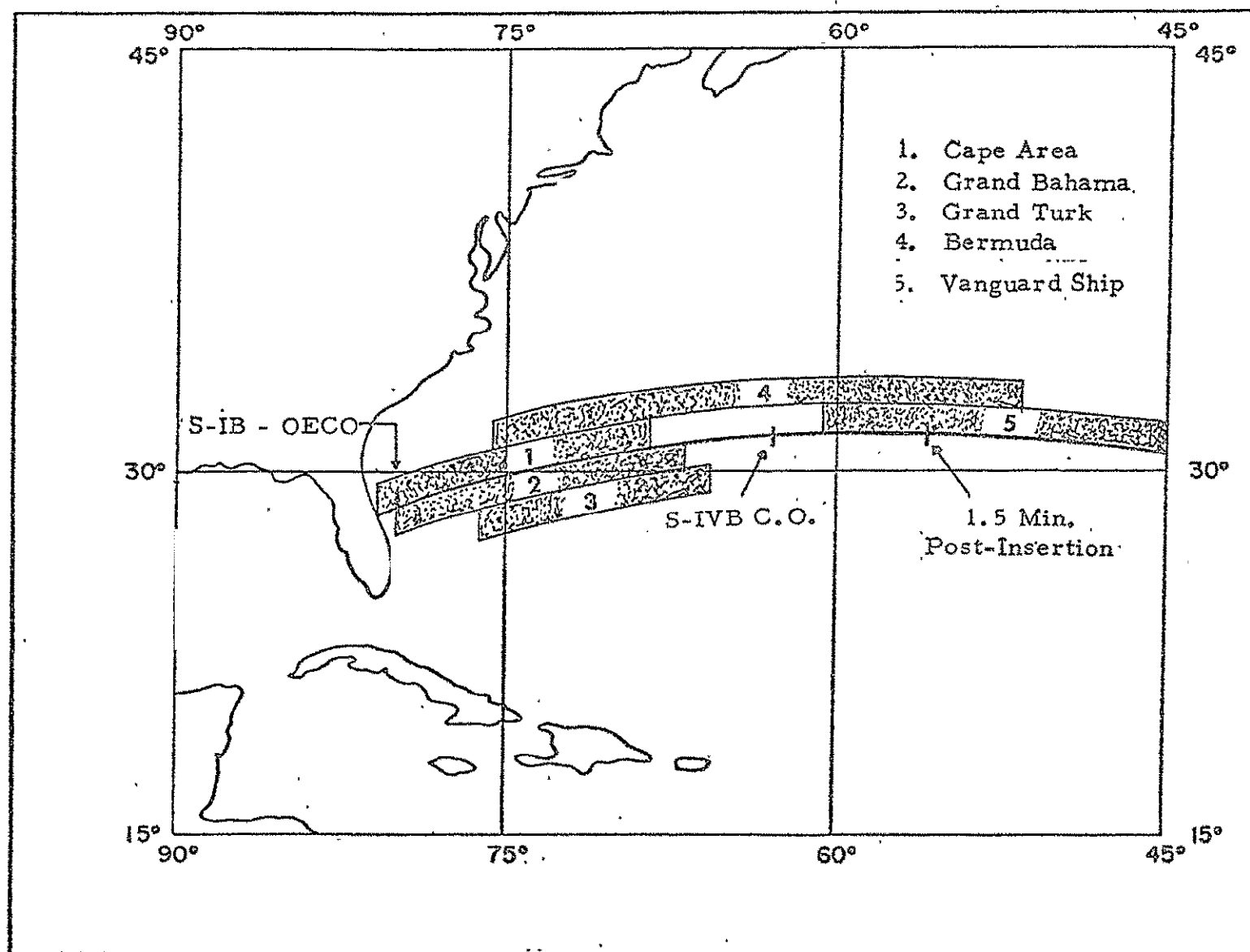
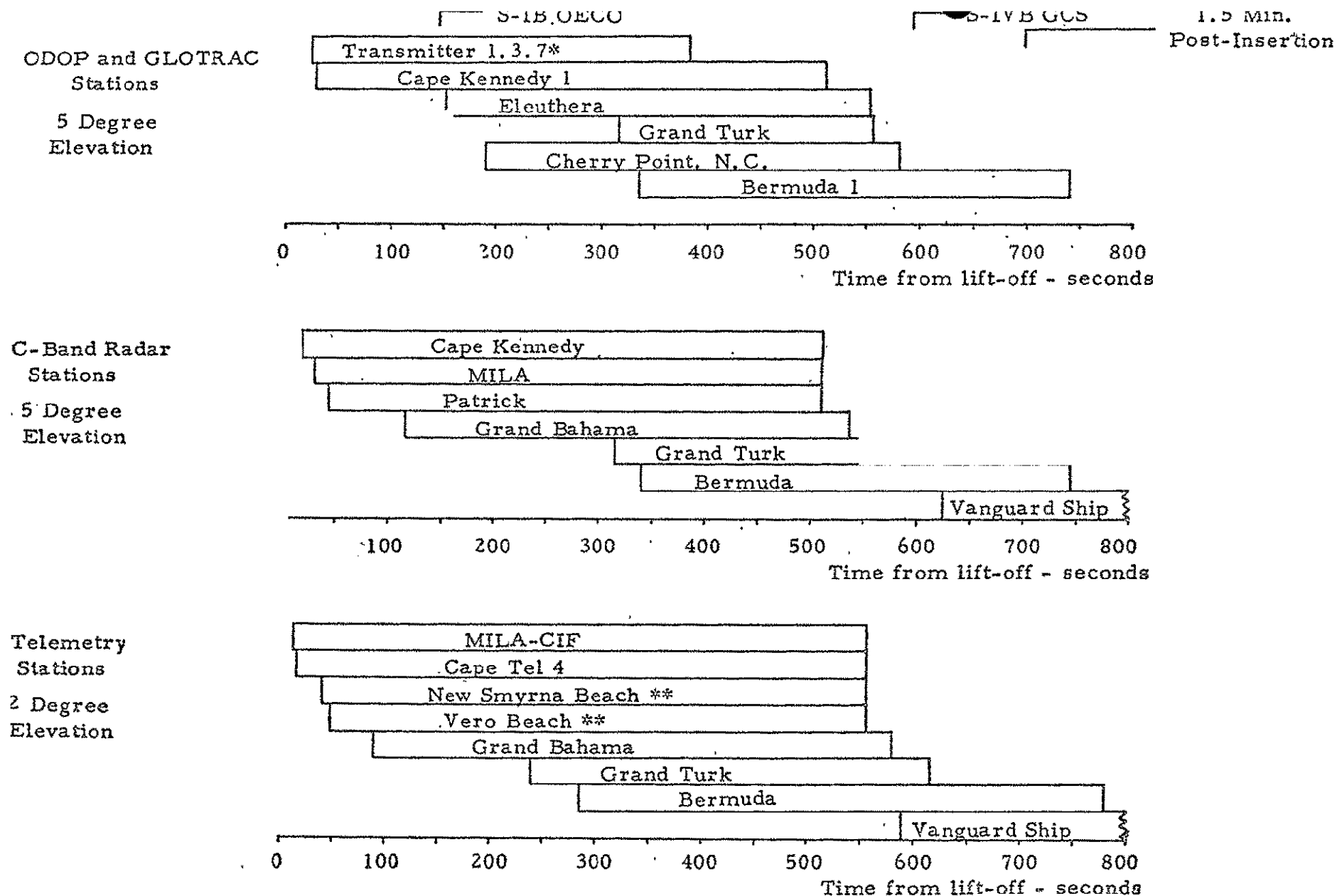


FIGURE 18. LAUNCH PHASE GROUND PROJECTION WITH COMMUNICATION COVERAGE ABOVE 5 DEGREE ELEVATION ANGLE



* Tracks S-IB Stage Only

** Measures Signal Strength Only

FIGURE 19 LAUNCH PHASE MISSION TIMELINE WITH TRACKING AND TELEMETRY COVERA

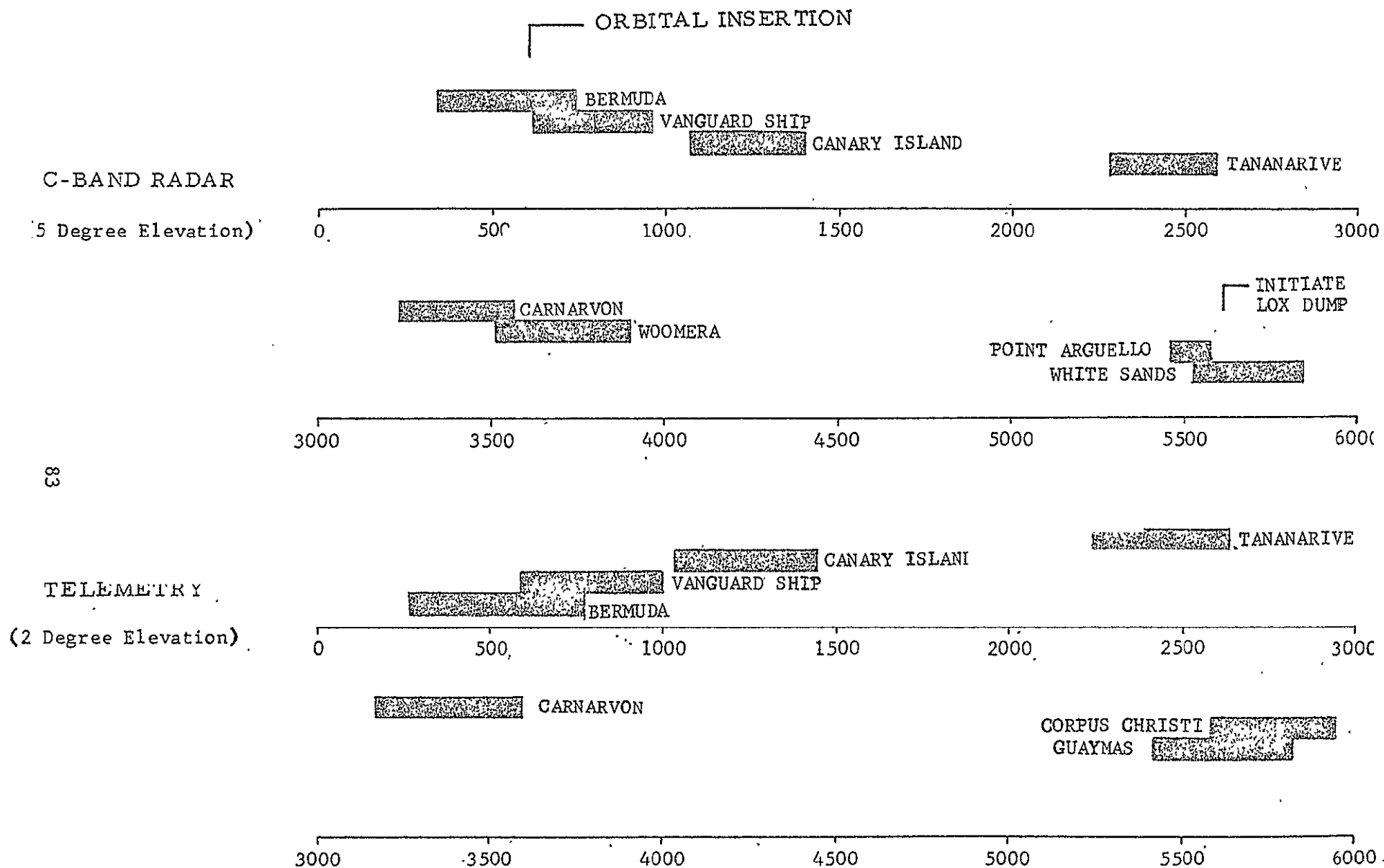


FIGURE 19 (cont'd)
ORBITAL PHASE MISSION TIMELINE WITH C-BAND RADAR AND TELEMETRY COVERAGE

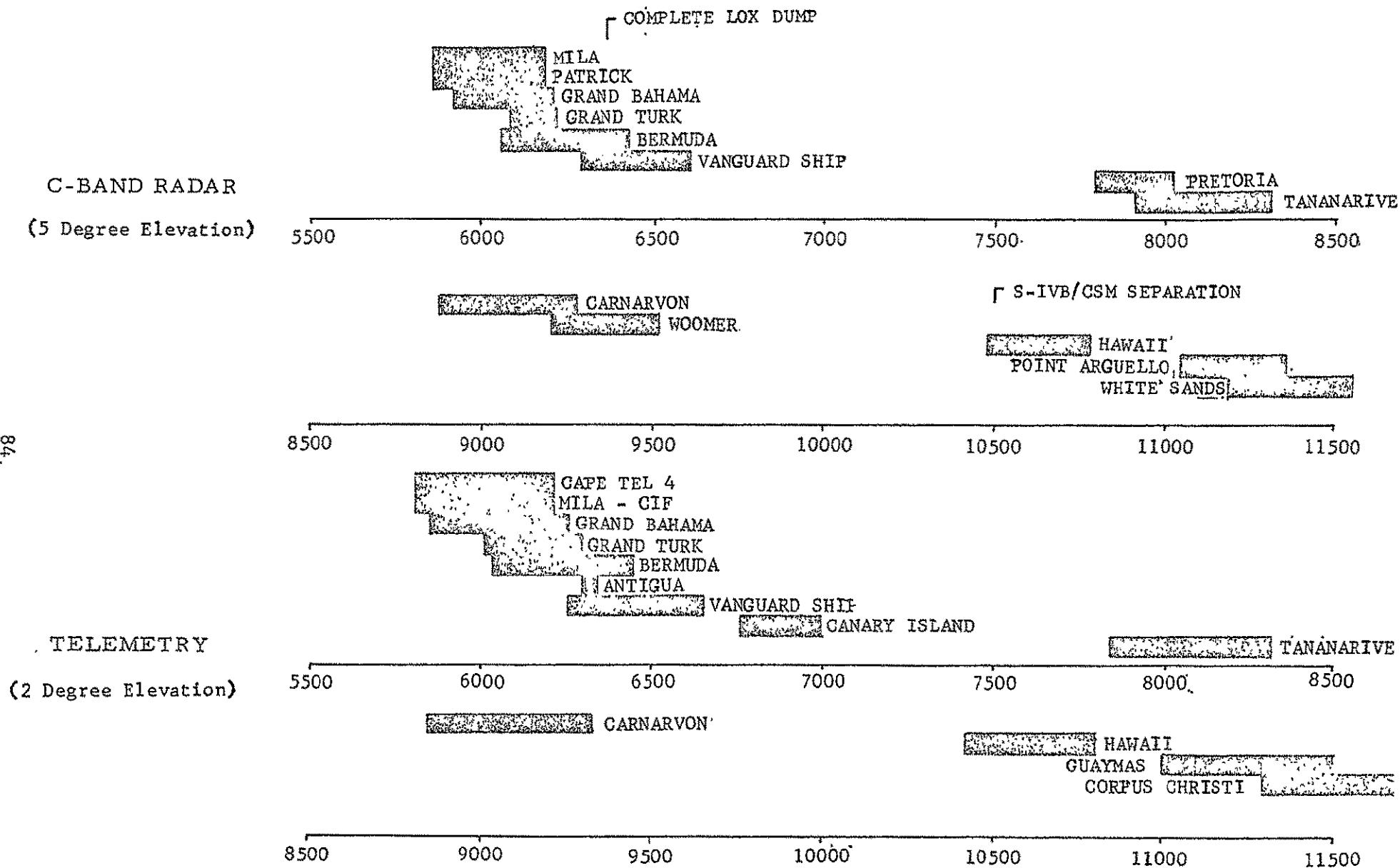
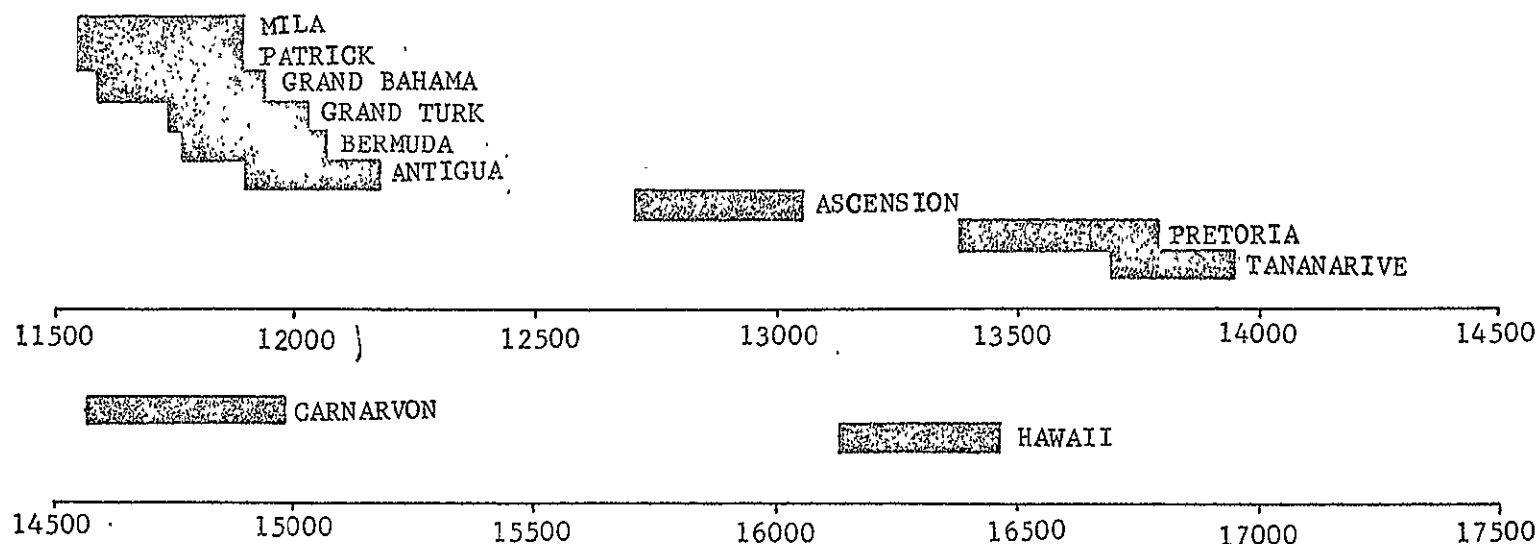


FIGURE 19 (cont'd)
ORBITAL PHASE MISSION TIMELINE WITH C-BAND RADAR AND TELEMETRY COVERAGE

— C-BAND RADAR
(5 Degree Elevation)



85

TELEMETRY
(2 Degree Elevation)

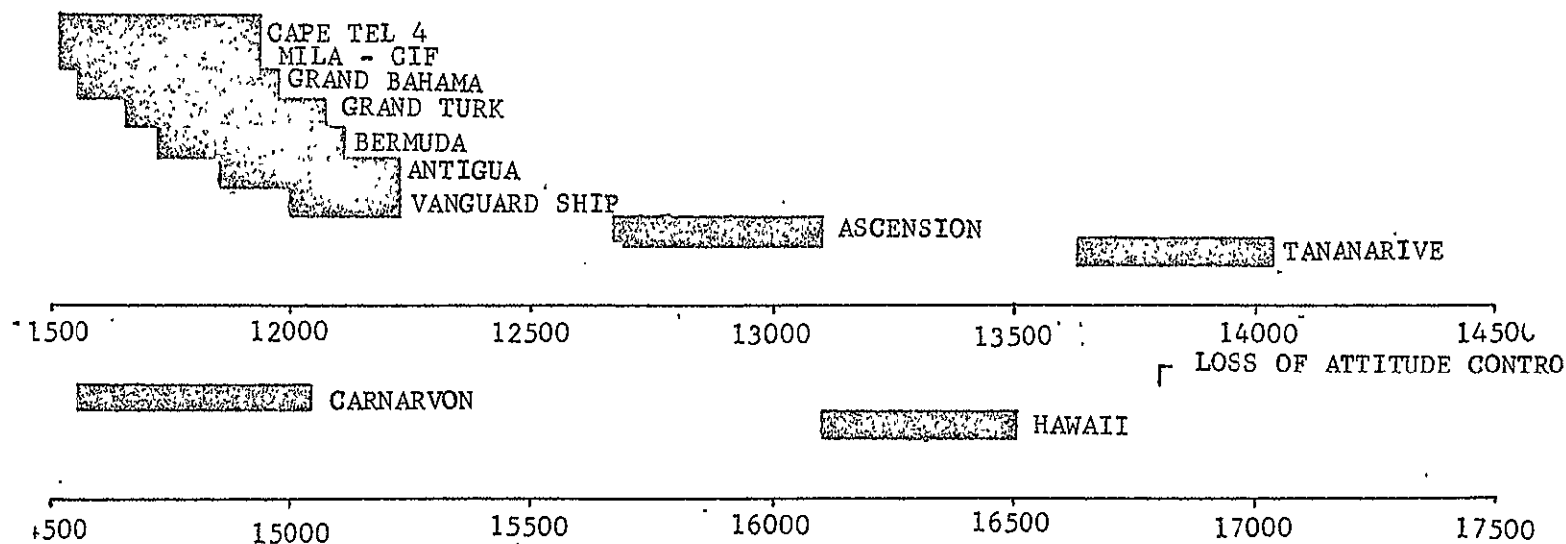


FIGURE 19 (cont'd)
ORBITAL PHASE MISSION TIMELINE WITH C-BAND RADAR AND TELEMETRY COVERAGE.

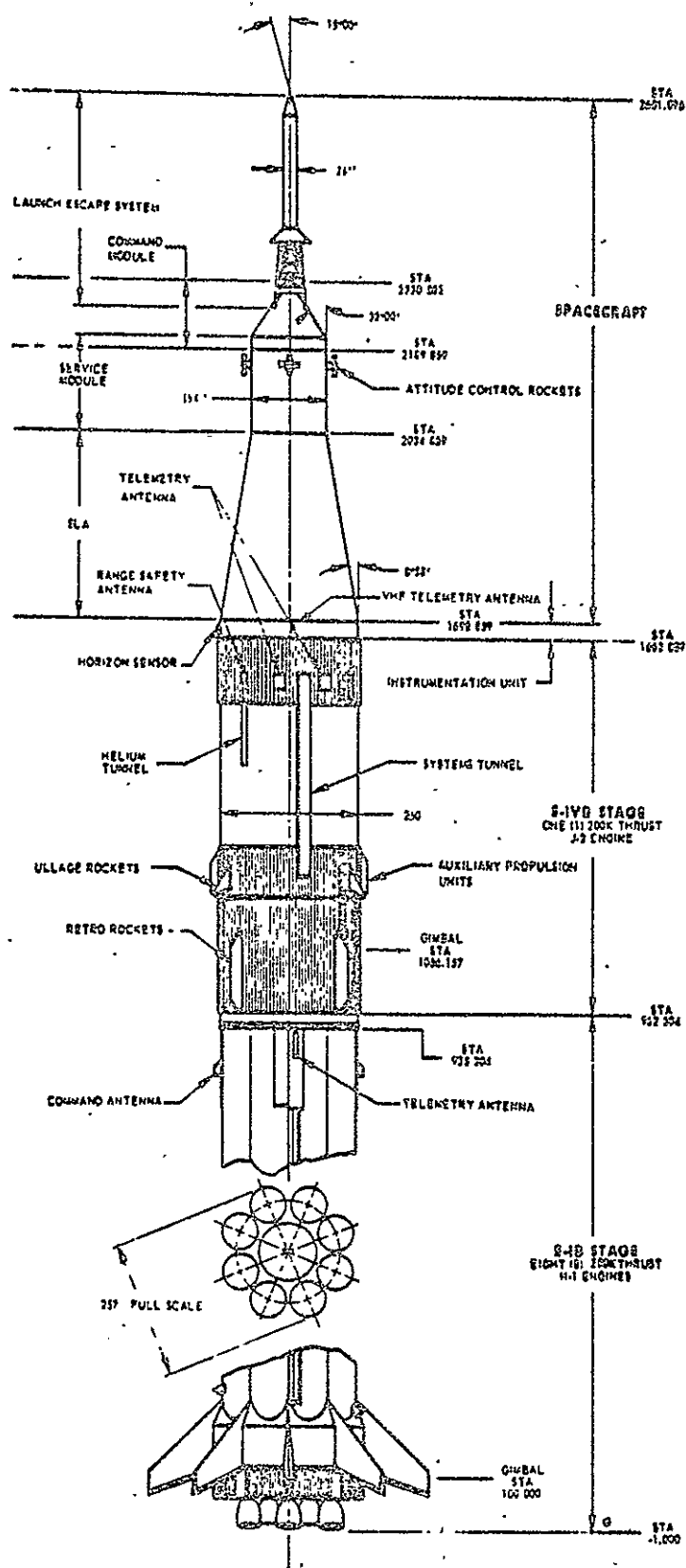


FIGURE 20 AS-205 VEHICLE PROFILE

APPENDIX A

"ORBITAL TIMELINE AND VENTING SEQUENCE "

TABLE 1A

AS-205/CSM-101 LAUNCH VEHICLE OPERATIONAL TRAJECTORY ORBITAL VENT SEQUENCE & IMPULSE HISTORY

	FLIGHT TIME (HR:MIN:SEC)	TIME FROM TB4 (SEC)	FLIGHT TIME (HR:MIN:SEC)	TIME FROM TB4 (SEC)	EFFECTIVE IMPULSE (LB-SEC)	TANK OR SPHERE AFFECTED AND DESCRIPTION OF EVENT
	START		END			
	0:10:15.2	0.4	0:31:15.2	1260.4	0.	LH ₂ Tank (LH ₂ Blowdown)
	0:10:15.4	0.6	Open Permanently		0.	LH ₂ Tank (Secondary NPV Open)
	0:10:45.0	30.2	0:11:15.0	60.2	2237.	LOX Tank (LOX Blowdown)
	0:54:04.8	2630.0	0:59:04.8	2930.0	0.	LH ₂ Tank (LH ₂ Blowdown)
* 88	1:34:26.8	5052.0	1:46:27.8	5773.0	4700.	LOX Tank (LOX Dump)
	1:34:36.8	5062.0	Open Permanently		0.	LOX Tank (NPV Valves Open)
	1:34:40.8	5066.0	1:44:43.8	5669.0	0.	LH ₂ Tank (LH ₂ Blowdown)
	1:42:26.8	5532.0	2:30:14.8	8400.0	0.	Helium Sphere (Partial Helium Dump Through LOX Tank NPV)
	3:17:31.8	11237.0	4:41:22.1	16267.3	0.	Stage Control Sphere (Helium Dump)
	4:30:14.8	15600.0	4:50:18.4	16800.0	0.	Helium Sphere (Complete Helium Dump Through LOX Tank NPV)

* Based on nominal residuals. The $\pm 3 \sigma$ impulse values are 24,500 and 80,000 lb-seconds, respectively. Based on these impulse values and the associated mass data, the approximate ΔV 's imparted to the configuration are 8.1, and 11.8 meters/second.

TABLE 2A
AS-205/CSM-101 LAUNCH VEHICLE OPERATIONAL TRAJECTORY
ORBITAL ATTITUDE TIMELINE

MANEUVER	TIME*	
	SECONDS	HR:MIN:SEC
1. Maintain cutoff inertial attitude for 20 seconds after initiation of time base four (tb4).	tb4 + 0.0	0:10:14.8
2. Initiate maneuver to align the S-IVB/CSM along the local horizontal (CSM forward, position I down) and maintain with respect to local reference.	tb4 + 20.0	0:10:34.8
3. Begin orbital safing sequence by enabling J-2 engine dump. Maintain vehicle attitude as defined in paragraph above.	tb4 + 4860	1:31:14.8
4. Begin manual control of S-IVB attitude from the spacecraft. Maneuvers in roll, pitch and yaw will be based on maximum commandable rates of 0.3°/second in pitch and yaw, and 0.5°/second in roll.	9000	2:30:00
5. End manual control of S-IVB attitude from the spacecraft. The I. U. will return to its programmed timeline whenever the spacecraft relinquishes attitude control.	9180	2:33:00
6. Initiate maneuver to pitch nose down 20° from the local horizontal (position I down) and maintain orbital rate.	9780	2:43:00
7. Initiate inertial attitude hold using gimbal angles at the specified initiation time. Maintain inertial attitude.	10275	2:51:15
8. Nominal CSM physical separation.	10500	2:55:00
9. Initiate maneuver to align the S-IVB/IU along the local horizontal, tail leading and roll to position I up. Maintain orbital rate.	11820	3:17:00

* Times other than those noted at time base four (tb4) are ground elapsed time from launch vehicle GRR.

APPENDIX B

"GUIDANCE PRESETTINGS"

TABLE 1B:

AS-205/CSM-101 LAUNCH VEHICLE FLIGHT TRAJECTORY
S-IB STAGE UNBIASED PITCH PROGRAM

For the time segment $T \leq 10$:

$$\begin{aligned} \chi_y &= 0. \\ \chi_z &= 0. \\ \chi_x &= -.488692 \text{ rad } (-28.0 \text{ degrees}) \end{aligned}$$

For the time segment $10 < T \leq 63.8$:

$$\begin{aligned} \chi_y &= A_0 + A_1T + A_2T^2 + A_3T^3 \\ A_0 &= -.139871 \times 10^{-1} \text{ rad} \\ A_1 &= +.320258 \times 10^{-2} \text{ rad/sec} \\ A_2 &= -.222830 \times 10^{-3} \text{ rad/sec}^2 \\ A_3 &= +.114730 \times 10^{-5} \text{ rad/sec}^3 \\ \chi_x &= \chi_z = 0. \end{aligned}$$

For the time segment $63.8 < T \leq 109.8$

$$\begin{aligned} \chi_y &= B_0 + B_1T + B_2T^2 + B_3T^3 \\ B_0 &= +.337135 \times 10^0 \text{ rad} \\ B_1 &= -.108052 \times 10^{-1} \text{ rad/sec} \\ B_2 &= -.384334 \times 10^{-4} \text{ rad/sec}^2 \\ B_3 &= +.350965 \times 10^{-6} \text{ rad/sec}^3 \\ \chi_x &= \chi_z = 0. \end{aligned}$$

For the time segment $109.8 < T \leq 134.3$:

$$\begin{aligned} \chi_y &= C_0 + C_1T + C_2T^2 + C_3T^3 \\ C_0 &= +.210868 \times 10^0 \text{ rad} \\ C_1 &= -.978481 \times 10^{-2} \text{ rad/sec} \\ C_2 &= -.101180 \times 10^{-4} \text{ rad/sec}^2 \\ C_3 &= +.103404 \times 10^{-6} \text{ rad/sec}^3 \\ \chi_x &= \chi_z = 0. \end{aligned}$$

For the time segment > 134.3 :

$$\begin{aligned} \chi_y &= -1.0352499 \text{ rad} \\ \chi_x &= \chi_z = 0. \end{aligned}$$

T = Time from time base one

TABLE 2B

AS-205/CSM-101 LAUNCH VEHICLE FLIGHT TRAJECTOR
S-IB STAGE UNBIASED PITCH ATTITUDE COMMAND

<u>TIME</u> <u>(T) (SEC)</u>	<u>PITCH ATTITUDE</u> <u>COMMAND, χ_c (DEG)</u>	<u>TIME</u> <u>(T) (SEC)</u>	<u>PITCH ATTITUDE</u> <u>COMMAND, χ_c (DEG)</u>
0.	0.00	81.8	-35.05
10.	0.00	83.8	-36.19
11.8	- .31	85.8	-37.31
13.8	- .53	87.8	-38.40
15.8	- .83	89.8	-39.47
17.8	-1.21	91.8	-40.52
19.8	-1.66	93.8	-41.53
21.8	-2.19	95.8	-42.52
23.8	-2.78	97.8	-43.48
25.8	-3.44	99.8	-44.41
27.8	-4.15	101.8	-45.31
29.8	-4.93	103.8	-46.18
31.8	-5.76	105.8	-47.02
33.8	-6.65	107.8	-47.82
35.8	-7.58	109.8	-48.59
37.8	-8.56	111.8	-49.56
39.8	-9.58	113.8	-50.49
41.8	-10.64	115.8	-51.41
43.8	-11.73	117.8	-52.32
45.8	-12.86	119.8	-53.21
47.8	-14.02	121.8	-54.10
49.8	-15.21	123.8	-54.97
51.8	-16.42	125.8	-55.82
53.8	-17.65	127.8	-56.67
55.8	-18.89	129.8	-57.50
57.8	-20.16	131.8	-58.31
59.8	-21.43	133.8	-59.12
61.8	-22.71	134.3	-59.31
63.8	-23.99		
65.8	-25.23		
67.8	-26.51		
69.8	-27.79		
71.8	-29.04		
73.8	-30.28		
75.8	-31.51		
77.8	-32.71		
79.8	-33.89		
		↓	↓
		IGM Start	-59.31

T = Time from time base one

TABLE 3B
 ΔC-205/CSM-101 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY.
 IGM PRESETTINGS

<u>LVDC SYMBOL</u>	<u>INITIAL VALUE</u>	<u>UNITS</u>	<u>DESCRIPTION</u>
-----	25.	sec	Time from time base 3 to initiate IGM guidance.
T1i	286.3	sec	Time to go for first IGM stage.
T3i	159.8	sec	Time to go for second IGM stage.
T ₃	326.5	sec	Average value of m/ṁ at initiation of second IGM stage.
Vex1	4151.0	m/sec	Average exhaust velocity (go x Isp) for 1st IGM stage phase of flight.
Vex3	4233.2	m/sec	Average exhaust velocity (go x Isp) for 2nd IGM stage phase of flight.
VT	7780.67	m/sec	Guidance Cutoff Signal (GCS) criteria. Terminal velocity for IGM equations.
XVT	6600405	m	Desired terminal position vector components in IGM coordinate system.
YVT	0.	m	
ZVT	0.	m	
$\dot{X}VT$	0.	m/sec	Desired cutoff velocity components in IGM coordinate system.
$\dot{Y}VT$	0.	m/sec	
$\dot{Z}VT$	7780.67	m/sec	
$\ddot{X}VG$	-9.15	m/sec ²	Terminal gravitation vector components in IGM coordinate system.
$\ddot{Y}VG$	0	m/sec ²	
$\ddot{Z}VG$	0	m/sec ²	

TABLE 3B (Cont'd)
AS-205/CSM-101 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY
IGM PRESETTINGS

<u>LVDC YMBOL</u>	<u>INITIAL VALUE</u>	<u>UNITS</u>	<u>DESCRIPTION</u>
	25.	sec	Value of T3i to initiate IGM $\Delta \bar{V}$ guidance.
-----	5.	sec	Value of T3i to freeze IGM (ϵ').
TR1	1.8	N/D	Mission dependent constant multiplier for terminal range angle equation.
TR2	0.	N/D	Mission dependent constants for N2 and N4 equations.
TR3	0.	N/D	
-----	56.89	sec	Time from time base 3 to initiate thrust misalignment correction.
\tilde{T}_2	0.	sec	N2 and N4 multipliers for χ'_y and χ'_z .
Δ TNOM	R-AS1	sec	Nominal computation cycle length.
\tilde{TLD}	0.	N/D	IGM staging flag (burn switch).
AP1	-.42597028 E+00	N/D	Transformation matrix from navigation coordinate system to the (X4, Y4, Z4) coordinate system $A_z = 72.$ $\phi_L = 28.521963.$ $\theta_N = 119.0$ $i = 31.605$
AP2	.50108032 E-01	N/D	
AP3	.90334849 E+00	N/D	
AP4	-.39490759 E-02	N/D	
AP5	.99835259 E+00	N/D	
AP6	-.57239996 E-01	N/D	
AP7	-.90472851 E+00	N/D	
AP8	-.27949930 E-01	N/D	
AP9	-.42507067 E+00	N/D	
-----	1000.	sec	Time from time base 3 to sample F/M for IGM staging.
FLAG	N/A	N/D	Number of F/M decreases required for IGM staging criteria.

TABLE 3B (Cont'd)
AS-205/CSM-101 LAUNCH VEHICLE OPERATIONAL FLIGHT TRAJECTORY
IGM PRESETTINGS

<u>LVDC SYMBOL</u>	<u>INITIAL VALUE</u>	<u>UNITS</u>	<u>DESCRIPTION</u>
ACC	N/A	m/sec ²	F/M comparison tolerance for IGM staging.
T10	286.3	sec	Constants for updating second stage time-to-go for perturbed EMR shift time.
A0	N/A	sec	
A1	N/A	N/D	
PC0	0.	sec	Backup time for IGM staging.
T10	536.0	sec	Constants for artificial T3 mod
C0	35.	sec	
M02	129761.6	kg	
* M ₁	239.7877	kg/sec	
* M ₃	183.1797	kg/sec	
* M03	134374.	kg	Mass at J-2 start command minus mass to be jettisoned.
* M1	585943.	kg	Mass at first motion.
* F1	7600000.	kg m/sec ²	S-IB thrust.
* F2	995355.2	kg m/sec ²	S-IVB average first burn thrust, from 90% thrust to IGM staging.
* F3	775441.26	kg m/sec ²	S-IVB average second burn thrust from IGM staging to cutoff.
* M ₂	2820.8	kg/sec	Average S-IB flow rate from first motion to IECD.

* Biased values for accelerometer failure cases from R-ASTR-NG-115-68.

APPENDIX C

"TRAJECTORY LISTING, ENGLISH UNITS"

TABLE 1C

S-1B POWERED FLIGHT TABLES

TIME	ALT	RRR	VTH	VVV	AZ	AH
(SEC)	(FT)	(FT)	(DEG)	(FT/S)	(DEG)	(LB- FT/FT2=RAD)
5.00	113.	20909761.	90.00	1341.76	90.00	0.
0.00	113.	20909761.	90.00	1341.76	90.00	0.
5.00	213.	20910061.	88.22	1342.25	89.99	67.
10.00	540.	20910388.	86.15	1344.26	89.98	1254.
15.00	1126.	20910974.	83.82	1349.28	89.97	7421.
20.00	2004.	20911852.	81.23	1360.10	89.93	27256.
25.00	3211.	20913059.	78.44	1379.25	89.83	76578.
30.00	4781.	20914629.	75.51	1409.44	89.65	180520.
35.00	6749.	20916597.	72.55	1453.41	89.34	375176.
40.00	9152.	20918999.	69.65	1513.34	88.92	709167.
45.00	12023.	20921870.	66.93	1590.96	88.36	1243714.
50.00	15398.	20925244.	64.48	1687.63	87.68	2050507.
55.00	19386.	20929151.	62.37	1803.61	86.91	3207246.
60.00	23767.	20933611.	60.71	1936.40	86.07	4781528.
65.00	28772.	20938614.	59.60	2081.37	85.21	6790105.
70.00	34313.	20944153.	58.80	2246.45	84.32	9225805.
75.00	40428.	20950264.	58.22	2434.82	83.42	12087703.
80.00	47158.	20956991.	57.82	2647.34	82.53	15336926.
85.00	54547.	20964376.	57.59	2884.27	81.60	18851796.
90.00	62637.	20972460.	57.56	3147.73	80.88	22365033.
95.00	71454.	20981270.	57.72	3438.74	80.11	25613234.
100.00	81026.	20990834.	58.01	3756.80	79.41	28508397.
105.00	91380.	21001181.	58.40	4102.23	78.77	31006685.
110.00	102549.	21012339.	58.86	4475.85	78.20	33089589.
115.00	114568.	21024338.	59.37	4879.18	77.68	34757560.
120.00	127438.	21037201.	59.97	5314.70	77.21	36059918.
125.00	141148.	21050345.	60.62	5784.50	76.78	37082078.
130.00	155854.	21065586.	61.32	6291.05	76.41	37796354.
134.50	169835.	21079550.	61.96	6780.82	76.10	38292432.
135.00	171435.	21081148.	62.04	6837.35	76.07	38353944.
140.00	187973.	21097665.	62.71	7426.73	75.78	38770758.
1) 140.11	188349.	21098040.	62.72	7440.19	75.77	38775172.
2) 143.11	198657.	21106334.	63.17	7627.97	75.70	38961487.
144.41	203126.	21112797.	63.40	7631.53	75.70	39022199.
3) 144.47	203396.	21113067.	63.42	7630.72	75.70	39027177.

- 1) Inboard Cutoff
- 2) Outboard Cutoff
- 3) Separation

TABLE 1C

S-IB POWERED FLIGHT TABLES

TIME	MASS	THRUST	VTHE	AZI	RANGE	VVVE
(SEC)	(LB)	(LB)	(DEG)	(DEG)	(FT)	(FT/S)
-5.00	1291782.73	0.	N/A	N/A	0.	0.00
0.00	1291782.73	1562203.	N/A	N/A	0.	0.00
5.00	1261107.83	1607473.	0.40	N/A	1.	41.69
10.00	1230432.94	1617234.	0.45	N/A	-3.	90.16
15.00	1199440.14	1632437.	0.28	N/A	-7.	145.28
20.00	1168447.34	1644747.	0.79	54.85	10.	207.29
25.00	1137283.84	1655890.	2.09	66.75	34.	276.66
30.00	1106120.34	1667434.	3.90	69.42	115.	353.48
35.00	1074901.05	1680361.	6.15	70.29	287.	438.40
40.00	1043681.74	1694984.	8.74	70.61	602.	532.36
45.00	1012429.84	1710295.	11.58	70.82	1117.	636.33
50.00	981177.94	1726048.	14.59	71.02	1902.	751.37
55.00	949924.69	1741473.	17.70	71.18	3035.	877.98
60.00	918671.44	1754691.	20.84	71.30	4596.	1013.71
65.00	887314.09	1768246.	24.04	71.40	6662.	1153.38
70.00	855956.76	1782925.	27.25	71.50	9322.	1308.86
75.00	824555.04	1796101.	30.33	71.57	12681.	1485.79
80.00	793166.66	1807262.	33.25	71.63	16849.	1685.71
85.00	761868.81	1816407.	35.95	71.69	21941.	1909.58
90.00	730570.95	1822644.	38.54	71.75	28077.	2158.83
95.00	699404.64	1826569.	41.03	71.80	35399.	2434.48
100.00	668238.37	1828101.	43.36	71.85	44049.	2737.13
105.00	637127.26	1827945.	45.52	71.89	54165.	3067.55
110.00	606016.19	1826472.	47.51	71.93	65887.	3426.78
115.00	575010.75	1823611.	49.36	71.97	79359.	3816.26
120.00	544005.36	1819090.	51.12	72.02	94742.	4238.00
125.00	513161.82	1814073.	52.81	72.05	112211.	4694.33
130.00	482317.86	1807687.	54.41	72.09	131948.	5187.81
134.50	454782.24	1800289.	55.77	72.13	151813.	5666.25
135.00	451722.75	1799344.	55.92	72.13	154150.	5721.54
140.00	421127.66	1787093.	57.28	72.18	179019.	6299.69
1) 140.11	420458.86	1786680.	57.31	72.18	179598.	6312.94
2) 143.11	409321.08	1786845.	57.98	72.22	195703.	6494.26
144.41	407542.83	46942.	58.26	72.23	202810.	6494.74
3) 144.49	407516.02	44478.	58.28	72.23	203242.	6493.74

- 1) Inboard Cutoff
- 2) Outboard Cutoff
- 3) Separation

TABLE- 1C

S-IB POWERED FLIGHT TABLES

TIME	X	Y	Z	DX	DY	DZ
(SEC)	(FT)	(FT)	(FT)	(FT/S)	(FT/S)	(FT/S)
5.00	20909879.	55930.	18173.	0.00	414.63	1276.09
0.00	20909877.	58002.	11792.	0.00	414.41	1276.17
5.00	20909874.	60074.	6411.	40.83	414.03	1276.14
10.00	20910296.	62143.	969.	88.87	413.66	1275.94
15.00	20910874.	64211.	7349.	143.56	413.52	1276.30
20.00	20911743.	66278.	13737.	205.12	413.37	1279.43
25.00	20912738.	68344.	20151.	273.89	413.32	1287.05
30.00	20914493.	70411.	26618.	349.62	413.24	1301.35
35.00	20916446.	72477.	33179.	432.35	413.01	1324.73
40.00	20918829.	74541.	39884.	522.12	412.57	1359.18
45.00	20921678.	76602.	46793.	618.73	412.02	1406.61
50.00	20925027.	78661.	53975.	721.82	411.54	1468.91
55.00	20928785.	80717.	61509.	830.29	411.05	1547.48
60.00	20933333.	82771.	69477.	940.31	410.52	1642.24
65.00	20938297.	84823.	77956.	1045.15	410.01	1752.62
70.00	20943792.	86871.	87037.	1154.09	409.48	1883.32
75.00	20949852.	88917.	96826.	1271.25	408.87	2035.95
80.00	20956518.	90960.	107435.	1396.66	408.26	2211.58
85.00	20963832.	93000.	118986.	1530.33	407.65	2410.59
90.00	20971832.	95037.	131587.	1670.26	406.99	2636.82
95.00	20980542.	97070.	145398.	1814.64	406.24	2892.58
100.00	20987987.	99099.	160560.	1963.97	405.44	3176.78
105.00	21000190.	101124.	177214.	2116.13	404.43	3489.74
110.00	21011176.	103143.	195506.	2277.29	403.27	3832.05
115.00	21022971.	105156.	215588.	2440.73	401.77	4205.68
120.00	21035587.	107163.	237621.	2606.06	400.54	4614.54
125.00	21049034.	109161.	261794.	2773.04	398.41	5060.83
130.00	21063320.	111146.	288295.	2941.88	395.94	5546.70
134.50	21076904.	112423.	314307.	3095.64	393.58	6020.11
135.00	21078456.	113120.	317331.	3112.82	393.31	6074.94
140.00	21094462.	115079.	344116.	3293.60	380.48	6644.89
1) 140.11	21094825.	115122.	349847.	3297.84	390.42	6657.95
2) 143.11	21104769.	116272.	370143.	3321.30	389.42	6855.89
144.41	21109071.	116798.	379075.	3291.53	389.21	6874.20
3) 144.49	21109331.	116829.	379618.	3289.19	389.20	6874.42

- 1) Inboard Cutoff
- 2) Outboard Cutoff
- 3) Separation

TABLE 1C
S-IB POWERED FLIGHT TABLES

TIME	XE	YE	ZE	DXE	DYE	DZE
(SEC)	(FT)	(FT)	(FT)	(FT/S)	(FT/S)	(FT/S)
5.00	114.	-0.	-0.	0.00	0.00	0.00
0.00	114.	-0.	-0.	0.00	0.00	0.00
5.00	214.	-0.	-0.	41.69	0.16	0.13
10.00	541.	-2.	-1.	90.15	0.33	0.48
15.00	1127.	-3.	-5.	145.28	0.30	0.32
20.00	2005.	-5.	-0.	207.28	0.29	2.54
25.00	3212.	-6.	28.	276.49	0.19	9.83
30.00	4782.	-7.	109.	352.69	0.14	23.72
35.00	6750.	-8.	280.	435.92	0.24	46.60
40.00	9153.	-10.	593.	526.25	0.55	80.45
45.00	12024.	-14.	1108.	623.49	0.92	127.18
50.00	15399.	-19.	1890.	727.30	1.31	188.67
55.00	19307.	-27.	3020.	836.61	1.61	266.31
60.00	23768.	-35.	4580.	947.61	1.92	360.03
65.00	28772.	-46.	6045.	1053.59	2.15	469.30
70.00	34312.	-57.	9306.	1163.86	2.31	598.78
75.00	40424.	-69.	12670.	1282.58	2.48	750.04
80.00	47152.	-81.	16845.	1409.81	2.54	924.14
85.00	54537.	-94.	21949.	1545.59	2.49	1121.47
90.00	62619.	-106.	28105.	1687.97	2.35	1345.85
95.00	71424.	-117.	35457.	1835.19	2.13	1599.61
100.00	80980.	-127.	44148.	1987.79	1.77	1881.64
105.00	91311.	-135.	54321.	2145.67	1.42	2192.25
110.00	102445.	-141.	66119.	2309.03	0.99	2532.04
115.00	114410.	-145.	79693.	2477.23	0.45	2902.96
120.00	127222.	-145.	95207.	2647.93	0.25	3308.95
125.00	140843.	-143.	112644.	2820.95	0.59	3752.19
130.00	155416.	-139.	132795.	2996.57	0.95	4234.85
134.50	169201.	-134.	152896.	3157.12	1.47	4705.21
135.00	170864.	-133.	155263.	3175.10	1.54	4759.70
140.00	187202.	-123.	180462.	3364.33	2.36	5326.11
1) 140.11	187573.	-123.	181049.	3368.76	2.38	5338.97
2) 143.11	197735.	-115.	197385.	3396.24	3.19	5635.41
144.41	202136.	-110.	204600.	3367.62	3.55	5553.45
3) 144.49	202402.	-110.	205039.	3365.34	3.57	5553.66

- 1) Inboard Cutoff
2) Outboard Cutoff
3) Separation

TABLE 1C
S-IB POWERED FLIGHT TABLES

TIME (SEC)	PHIP (DEG)	PHIY (DEG)	PHIR (DEG)	OPHIP (DEG/S)	OPHIY (DEG/S)	OPHIR (DEG/S)
5.00	0.00	0.00	23.00	-0.00	0.00	-0.00
0.00	-0.02	0.01	27.99	-0.00	0.00	-0.00
5.00	0.02	-0.02	24.01	-0.01	0.01	-0.01
10.00	0.02	-0.02	28.00	0.00	0.00	-0.01
15.00	-0.55	-0.05	24.68	-0.12	-0.04	-1.53
20.00	-1.40	0.07	19.17	-0.23	0.00	-0.86
25.00	-2.74	0.07	14.11	-0.31	-0.00	-0.98
30.00	-4.49	0.05	9.13	-0.39	-0.01	-1.00
35.00	-6.62	0.02	-4.13	-0.46	-0.01	-1.00
40.00	-9.03	-0.03	-0.19	-0.51	-0.01	-0.06
45.00	-11.68	-0.03	-0.01	-0.55	0.00	-0.00
50.00	-14.51	-0.03	-0.01	-0.58	-0.00	-0.00
55.00	-17.43	-0.03	-0.01	-0.59	-0.00	-0.00
60.00	-20.39	-0.04	-0.01	-0.60	-0.00	-0.00
65.00	-23.54	-0.04	-0.02	-0.62	-0.00	-0.00
70.00	-26.56	-0.05	-0.02	-0.59	-0.00	-0.00
75.00	-29.45	-0.05	-0.02	-0.62	0.00	0.00
80.00	-32.59	-0.05	-0.01	-0.62	0.00	0.00
85.00	-35.72	-0.05	0.00	-0.64	0.00	0.00
90.00	-38.84	-0.05	0.00	-0.59	0.00	-0.00
95.00	-41.52	-0.04	0.00	-0.50	0.00	-0.00
100.00	-43.93	-0.04	0.00	-0.46	0.00	-0.00
105.00	-46.12	-0.06	-0.00	-0.42	0.00	-0.00
110.00	-48.15	-0.06	-0.00	-0.39	-0.00	-0.00
115.00	-50.44	-0.06	-0.00	-0.47	-0.00	-0.00
120.00	-52.72	-0.07	-0.00	-0.45	-0.00	-0.00
125.00	-55.00	-0.16	-0.00	-0.42	0.01	0.00
130.00	-57.08	-0.15	-0.00	-0.41	-0.00	0.00
134.50	-58.89	-0.15	-0.00	-0.40	-0.00	0.00
135.00	-59.08	-0.15	-0.00	-0.37	-0.00	-0.00
140.00	-59.31	-0.16	-0.00	-0.01	-0.00	0.00
1) 140.11	-59.31	-0.16	-0.00	-0.01	-0.00	0.00
2) 143.11	-59.32	-0.08	-0.00	0.01	0.01	0.00
144.41	-59.31	-0.07	-0.00	0.00	0.00	-0.00
3) 144.49	-59.31	-0.07	-0.00	0.00	0.00	-0.00

- 1) Inboard Cutoff
- 2) Outboard Cutoff
- 3) Separation

TABLE 1C

S-IB POWERED FLIGHT TABLES

TIME	CHIP	CHIY	CHIR	LONG	DECL	LATT
(SEC)	(DEG)	(DEG)	(DEG)	(DEG)	(DEG)	(DEG)
5.00	0.00	0.00	0.00	-80.56	28.36	28.52
0.00	0.00	0.00	-28.00	-80.56	28.36	28.52
5.00	0.00	0.00	-28.00	-80.56	28.36	28.52
10.00	0.00	0.00	-28.00	-80.56	28.36	28.52
15.00	0.67	0.00	-23.20	-80.56	28.36	28.52
20.00	-1.66	0.00	-18.20	-80.56	28.36	28.52
25.00	-3.10	0.00	-13.20	-80.56	28.36	28.52
30.00	-4.93	0.00	-8.20	-80.56	28.36	28.52
35.00	-7.11	0.00	-3.20	-80.56	28.36	28.52
40.00	-9.58	0.00	0.00	-80.56	28.36	28.52
45.00	-12.30	0.00	0.00	-80.56	28.36	28.52
50.00	-15.21	0.00	0.00	-80.56	28.36	28.52
55.00	-18.27	0.00	0.00	-80.55	28.36	28.52
60.00	-21.43	0.00	0.00	-80.55	28.36	28.53
65.00	-24.62	0.00	0.00	-80.54	28.37	28.53
70.00	-27.79	0.00	0.00	-80.53	28.37	28.53
75.00	-30.90	0.00	0.00	-80.52	28.37	28.53
80.00	-33.89	0.00	0.00	-80.51	28.38	28.54
85.00	-36.76	0.00	0.00	-80.50	28.38	28.54
90.00	-39.47	0.00	0.00	-80.48	28.39	28.55
95.00	-42.03	0.00	0.00	-80.46	28.39	28.55
100.00	-44.41	0.00	0.00	-80.43	28.40	28.56
105.00	-46.60	0.00	0.00	-80.40	28.41	28.57
110.00	-48.59	0.00	0.00	-80.37	28.42	28.58
115.00	-50.95	0.00	0.00	-80.33	28.43	28.59
120.00	-53.21	0.00	0.00	-80.28	28.44	28.60
125.00	-55.40	0.00	0.00	-80.23	28.46	28.62
130.00	-57.50	0.00	0.00	-80.17	28.47	28.63
134.50	-59.32	0.00	0.00	-80.11	28.49	28.65
135.00	-59.32	0.00	0.00	-80.10	28.49	28.65
140.00	-59.32	0.00	0.00	-80.03	28.51	28.67
1) 140.11	-59.32	0.00	0.00	-80.03	28.51	28.67
2) 143.11	-59.32	0.00	0.00	-79.98	28.53	28.69
144.41	-59.32	0.00	0.00	-79.96	28.53	28.69
3) 144.49	-59.32	0.00	0.00	-79.96	28.53	28.69

1) Inboard Cutoff

2) Outboard Cutoff

3) Separation

TABLE 10

S-1B POWERED FLIGHT TABLES

TIME	MACH	DRAG	ALP	QQQ	VR	TACEL
(SEC)	(U)	(LB)	(DEG)	(LB/FT ²)	(FT/S)	(FT/52)
5.00	0.00	5.	N/A	0.	0.00	0.00
0.00	0.00	5.	N/A	0.	3.99	39.14
5.00	0.04	613.	4.70	2.	41.88	41.23
10.00	0.08	2689.	2.07	9.	90.24	42.45
15.00	0.13	6798.	1.00	24.	145.34	43.85
20.00	0.18	10202.	0.68	47.	207.42	45.25
25.00	0.25	13728.	0.52	80.	276.92	46.70
30.00	0.32	19285.	0.01	125.	353.72	48.19
35.00	0.39	25675.	-0.32	182.	438.45	49.78
40.00	0.48	32842.	-0.41	248.	532.03	51.49
45.00	0.58	40755.	-0.51	324.	635.15	53.31
50.00	0.69	49651.	-0.58	405.	748.69	55.23
55.00	0.82	67421.	-0.62	486.	873.01	56.96
60.00	0.96	118843.	-0.67	559.	1005.20	57.56
65.00	1.11	165779.	-0.87	611.	1139.70	58.38
70.00	1.29	150205.	-0.94	645.	1287.91	61.65
75.00	1.51	130426.	-0.74	640.	1458.57	65.27
80.00	1.76	110071.	-0.37	645.	1661.07	69.12
85.00	2.03	99658.	-0.14	591.	1899.63	73.36
90.00	2.28	70179.	0.14	495.	2161.46	77.46
95.00	2.53	52568.	0.07	397.	2480.76	81.90
100.00	2.81	38561.	0.03	310.	2744.80	86.47
105.00	3.11	27250.	-0.02	235.	3073.07	91.26
110.00	3.41	18399.	-0.14	172.	3424.96	96.33
115.00	3.72	11188.	-0.53	122.	3813.28	101.77
120.00	4.05	4892.	-0.99	85.	4234.94	107.68
125.00	4.40	659.	-1.51	58.	4691.19	114.11
130.00	4.79	-1650.	-1.91	39.	5184.61	121.13
134.50	5.26	-3121.	-2.28	28.	5663.00	128.05
135.00	5.32	-3268.	-2.32	27.	5718.28	128.86
140.00	6.00	-5187.	-3.11	18.	6296.38	137.42
1) 140.11	6.01	-5163.	-1.08	18.	6309.63	137.61
2) 143.11	6.30	-3726.	-0.35	13.	6490.82	142.14
144.41	6.35	-3143.	-0.04	11.	6491.40	142.95
3) 144.49	6.36	-3110.	-0.02	11.	6490.39	142.76

- 1) Inboard Cutoff
- 2) Outboard Cutoff
- 3) Separation

TABLE 2C					
ULLAGE AND J-2 BUILD-UP TABLES					
TIME	ALT	RNR	VTH°	VVV°	AZ°
(SEC)	(FT)	(FT)	(DEG)	(FT/S)	(DEG)
144.49	203396.	21113067.	63.82	7630.72	75.70
145.81	207888.	21117552.	63.68	7613.32	75.71
148.08	215492.	21125146.	64.11	7588.32	75.73
149.41	219882.	21129530.	64.35	7592.17	75.74

TABLE 20

ULLAGE AND J-2 BUILD-UP TABLES

TIME	MASS	THRUST	VTHE	AZI	RANGE	VVVE
(SEC)	(LB)	(LB)	(DEG)	(DEG)	(FT)	(FT/S)
144.42	305882.99	9289.	58.28	72.23	203242.	6453.74
145.81	304744.49	9240.	58.56	72.25	210468.	6473.12
148.08	305316.43	98266.	59.05	72.27	222884.	6442.66
149.41	305127.38	188491.	59.34	72.29	230162.	6443.46

TABLE 2C						
ULLAGE AND J-2 BUILD-UP TABLES						
TIME	X	Y	Z	DX	DY	DZ
(SEC)	(FT)	(FT)	(FT)	(FT/S)	(FT/S)	(FT/S)
144.49	21109331.	116029.	379618.	3239.19	389.20	6874.42
145.81	21113649.	117343.	388699.	3248.09	389.02	6874.68
148.08	21120946.	118226.	404313.	3179.83	388.71	6878.97
149.41	21125151.	118742.	413466.	3149.42	388.48	6897.19

TABLE 2C						
ULLAGE AND J-2 BUILD-UP TABLES						
TIME	X _E	Y _E	Z _E	D _{XE}	D _{YE}	D _{ZE}
(SEC)	(FT)	(FT)	(FT)	(FT/S)	(FT/S)	(FT/S)
144.49	202402.	-110.	206039.	3345.34	3.57	5553.66
145.81	206821.	-105.	212375.	3325.25	3.92	5553.73
148.08	214295.	-95.	224989.	3258.77	4.52	5557.72
149.41	218606.	-89.	232386.	3229.55	4.88	5575.68

TABLE 2C

ULLAGE AND J-2 BUILD-UP TABLES

TIME	PHIP	PHIY	PHIR	DPHIP	DPHIY	DPHIR
(SEC)	(DEG)	(DEG)	(DEG)	(DEG/S)	(DEG/S)	(DEG/S)
144.49	-58.31	-0.07	-0.00	0.00	0.00	-0.00
145.81	-59.30	-0.06	-0.00	0.02	0.01	0.00
148.08	-59.17	-0.05	0.02	0.10	-0.01	0.02
149.41	-59.03	-0.10	0.06	0.08	-0.06	0.05

TABLE 2C

ULLAGE AND J-2 BUILD-UP TABLES

TIME	CHIP	CHIY	CHIR	LONG	DECL	LATT
(SEC)	(DEG)	(DEG)	(DEG)	(DEG)	(DEG)	(DEG)
144.49	-59.32	0.00	0.00	-79.86	28.53	28.69
145.81	-59.32	0.00	0.00	-79.94	28.54	28.70
148.08	-59.32	0.00	0.00	-79.90	28.55	28.71
149.41	-59.32	0.00	0.00	-79.88	28.56	28.72

TABLE 20						
VILLAGE AND J-2 BUILD-UP TABLES						
TIME	MACH	DRAG	ALP	QQQ	VR	TACEL
(SEC)	(U)	(LB)	(DEG)	(LB/FT ²)	(FT/S)	(FT/S ²)
144.49	6.36	493.	0.02	11.	6490.34	0.93
145.81	6.39	412.	0.30	9.	6469.76	0.93
148.08	6.46	304.	0.96	6.	6439.28	10.32
149.41.	6.52	257.	1.41	5.	6440.08	19.85

TABLE 3C
S-IVB POWERED FLIGHT TABLES

TIME	ALT	RRR	VTH	VVV	AZ	RANGLE
(SEC)	(FT)	(FT)	(DEG)	(FT/S)	(DEG)	(DEG)
1) 149.41	219832.	21129530.	64.35	7592.17	75.74	0.63
150.00	221821.	21131466.	64.46	7596.02	75.74	0.64
156.41	242491.	21152105.	55.57	7657.73	75.73	0.74
163.11	263382.	21172964.	66.70	7733.82	75.73	0.84
170.00	284131.	21193679.	67.82	7822.90	75.72	0.95
190.00	340625.	21250071.	70.60	8103.45	75.93	1.28
210.00	392110.	21301450.	73.10	8425.24	76.17	1.63
230.00	433911.	21348142.	75.36	8769.49	76.44	2.01
250.00	481289.	21390417.	77.39	9197.03	76.73	2.41
270.00	519517.	21428518.	79.22	9647.68	77.04	2.83
290.00	553813.	21462693.	80.84	10143.37	77.36	3.28
310.00	584413.	21493168.	82.28	10686.32	77.70	3.76
330.00	611557.	21520184.	83.54	11276.78	78.05	4.27
350.00	635489.	21543984.	84.64	11919.84	78.42	4.81
370.00	656459.	21564019.	85.58	12617.97	78.81	5.39
390.00	674728.	21582949.	86.38	13374.60	79.22	6.00
410.00	690598.	21598677.	87.05	14198.90	79.66	6.66
430.00	704347.	21612301.	87.59	15094.63	80.12	7.37
450.00	716377.	21624163.	88.02	16072.29	80.61	8.12
2) 454.75	719013.	21626764.	88.10	16318.15	80.73	8.31
470.00	726682.	21634320.	88.49	16969.97	81.13	8.93
490.00	734589.	21642079.	88.94	17858.79	81.68	9.78
510.00	740424.	21647768.	89.27	18819.05	82.26	10.68
530.00	744446.	21651647.	89.56	19863.18	82.86	11.63
550.00	746825.	21653887.	89.79	21001.68	83.51	12.64
570.00	747901.	21654830.	89.94	22246.47	84.20	13.71
590.00	748162.	21654965.	90.01	23622.31	84.93	14.85
610.00	747865.	21654554.	90.04	25148.92	85.71	16.07
3) 614.63	747837.	21654501.	90.01	25527.13	85.90	16.36
4) 624.63	747811.	21654485.	90.00	25549.23	86.31	17.00

- 1) 90% Thrust
- 2) Mixture Ratio Shift
- 3) Guidance Cutoff
- 4) Orbit Insertion

TABLE 3C

S-IVB POWERED FLIGHT TABLES

TIME	MASS	THRUST	VTHE	AZI	RANGE	VVVE
(SEC)	(LB)	(LB)	(DEG)	(DEG)	(FT)	(FT/S)
1) 149.41	305127.30	188491.	59.34	72.29	230162.	6443.46
150.00	304835.79	197217.	59.46	72.29	233401.	6446.00
156.41	301593.43	227243.	60.81	72.36	268958.	6493.99
163.11	297808.85	227233.	62.18	72.43	306917.	6556.66
170.00	295139.55	227248.	63.55	72.49	346830.	6632.93
190.00	274437.63	226516.	66.98	72.94	467742.	6882.35
210.00	263711.34	227401.	70.05	73.41	596265.	7178.92
230.00	252992.89	227263.	72.82	73.89	732849.	7522.60
250.00	242268.85	226405.	75.31	74.39	878006.	7913.55
270.00	231566.65	227313.	77.52	74.89	1032313.	8350.93
290.00	220872.12	226251.	79.48	75.39	1196423.	8836.06
310.00	210170.11	227167.	81.19	75.90	1371038.	9370.70
330.00	199494.15	225985.	82.68	76.41	1556942.	9954.63
350.00	188794.69	226843.	83.96	76.93	1754973.	10592.57
370.00	178109.25	226238.	85.06	77.46	1966088.	11286.70
390.00	167440.08	226170.	85.98	78.01	2191303.	12040.21
410.00	156750.66	226192.	86.74	78.57	2431771.	12862.07
430.00	146089.71	226014.	87.36	79.15	2688814.	13755.77
450.00	135422.21	226555.	87.84	79.75	2963850.	14732.00
2) 454.75	132909.98	226627.	87.93	79.89	3031997.	14977.54
470.00	126482.26	175226.	88.36	80.36	3257436.	15628.35
490.00	118352.99	175194.	88.85	81.00	3567718.	16516.16
510.00	110225.04	175153.	89.22	81.60	3895767.	17475.70
530.00	102096.88	175109.	89.53	82.34	4243091.	18519.32
550.00	93974.86	175048.	89.78	83.06	4611421.	19657.47
570.00	85854.08	174961.	89.94	83.82	5002720.	20904.03
590.00	77738.29	174805.	90.01	84.64	5419265.	22277.73
610.00	69632.61	174503.	90.04	85.47	5863750.	23804.27
3) 614.63	67757.00	174397.	90.01	85.67	5971037.	24182.46
4) 624.63	67617.40	0.	90.00	86.11	6204635.	24204.52

- 1) 90% Thrust
- 2) Mixture Ratio Shift
- 3) Guidance Cutoff
- 4) Orbit Insertion

TABLE-3C

S-IVB POWERED FLIGHT TABLES

TIME	XE	YE	ZE	DXE	DYE	DZE
(SEC)	(FT)	(FT)	(FT)	(FT/S)	(FT/S)	(FT/S)
1) 149.41	216486.	69.	232386.	3229.55	4.08	5575.68
150.00	220508.	-66.	235678.	3217.72	5.02	5585.45
156.41	240746.	-51.	271858.	3098.94	5.90	5706.87
163.11	261106.	-8.	310542.	2979.16	6.98	5840.74
170.00	281222.	44.	351279.	2860.19	7.82	5984.56
190.00	335320.	473.	475026.	2554.44	37.26	6390.63
210.00	383466.	1554.	607024.	2261.89	71.71	6812.89
230.00	425827.	3378.	747695.	1974.59	111.50	7257.97
250.00	462480.	6044.	897523.	1690.65	155.71	7729.28
270.00	493455.	9632.	1057050.	1407.29	203.82	8228.97
290.00	518750.	14222.	1226897.	1121.50	255.72	8760.87
310.00	538305.	19888.	1407725.	833.17	311.61	9328.39
330.00	552826.	26713.	1608276.	537.79	371.56	9933.14
350.00	559773.	34781.	1805340.	235.18	436.09	10580.98
370.00	561351.	44189.	2023821.	-79.57	505.49	11275.10
390.00	556500.	55036.	2256674.	-407.98	580.16	12019.31
410.00	544917.	67436.	2504992.	-753.89	660.90	12822.94
430.00	526189.	81515.	2770002.	-1122.90	748.20	13689.43
450.00	499823.	97414.	3053052.	-1518.71	843.08	14629.24
2) 454.75	492375.	101475.	3123098.	-1617.37	866.85	14864.71
470.00	465064.	115207.	3354520.	-1970.14	933.90	15475.52
490.00	420765.	134790.	3672172.	-2464.57	1025.05	16299.04
510.00	366305.	156236.	4006871.	-2989.72	1120.44	17181.57
530.00	300797.	179655.	4359874.	-3570.89	1222.94	18130.59
550.00	223075.	205216.	4732589.	-4211.68	1334.78	19154.54
570.00	131904.	233117.	5126629.	-4916.92	1457.16	20265.22
590.00	25900.	263578.	5543874.	-5697.36	1590.97	21478.03
610.00	-96915.	296811.	5986464.	-6589.11	1735.33	22808.23
3) 614.63	-127925.	304934.	6092903.	-6797.80	1771.33	23139.66
4) 624.63	-197242.	322736.	6324103.	-7060.94	1787.69	23082.59

1) 90% Thrust

2) Mixture Ratio Shift

3) Guidance Cutoff

4) Orbit Insertion

TABLE 3C
S-IVB POWERED FLIGHT TABLES

TIME	X	Y	Z	DX	DY	DZ
(SEC)	(FT)	(FT)	(FT)	(FT/S)	(FT/S)	(FT/S)
1) 149.41	21125151.	118742.	413466.	3149.42	388.48	6897.19
150.00	21127005.	118971.	417538.	3137.04	388.35	6907.08
156.41	21146706.	121454.	462195.	3012.11	386.15	7029.85
163.11	21166463.	124033.	509747.	2885.68	383.84	7165.02
170.00	21185911.	126669.	559612.	2759.62	381.04	7310.07
190.00	21237765.	134453.	709904.	2432.33	399.25	7719.47
210.00	21283260.	142650.	866505.	2116.48	421.18	8144.19
230.00	21322461.	151327.	1035818.	1803.94	447.04	8590.76
250.00	21355432.	160651.	1212309.	1492.66	475.80	9062.61
270.00	21382155.	170374.	1398500.	1179.69	506.64	9561.86
290.00	21402502.	180838.	1594992.	861.80	539.92	10092.26
310.00	21416599.	191985.	1802423.	538.67	575.10	10657.23
330.00	21424850.	203855.	2021517.	206.57	612.29	11258.28
350.00	21424757.	216493.	2253036.	137.99	651.83	11901.21
370.00	21418433.	229945.	2497862.	497.20	693.78	12589.07
390.00	21404763.	244261.	2756919.	873.92	738.35	13325.58
410.00	21383332.	259499.	3031273.	1272.48	785.98	14119.90
430.00	21353667.	275721.	3322114.	1698.65	836.87	14975.25
450.00	21315164.	292949.	3630752.	2167.37	891.64	15901.87
2) 454.75	21304646.	297267.	3706835.	2271.79	905.27	16133.87
470.00	21266992.	311346.	3957516.	2672.18	940.93	16731.82
490.00	21208002.	330638.	4300105.	3232.36	988.23	17536.01
510.00	21137488.	350878.	4659328.	3828.18	1036.05	18396.42
530.00	21054460.	372099.	5036376.	4485.49	1086.64	19319.56
550.00	20957633.	394374.	5432678.	5208.54	1141.72	20313.50
570.00	20845646.	417802.	5849459.	6002.92	1201.93	21389.59
590.00	20716967.	442486.	6288802.	6880.38	1267.34	22562.53
610.00	20569450.	468501.	6752624.	7878.05	1335.92	23845.76
3) 614.63	20532408.	474731.	6863839.	8112.87	1353.28	24165.77
4) 624.63	20449802.	488243.	7105207.	8402.99	1398.19	24090.15

- 1) 90% Thrust
- 2) Mixture Ratio Shift
- 3) Guidance Cutoff
- 4) Orbit Insertion

TABLE 3C

S-IVB POWERED FLIGHT TABLES

TIME	PHIP	PHIY	PHIR	DPHIP	DPHIY	DPHIR
(SEC.)	(DEG)	(DEG)	(DEG)	(DEG/S)	(DEG/S)	(DEG/S)
1) 149.41	-58.03	-0.10	-0.06	-0.08	-0.06	-0.05
150.00	-58.99	-0.14	0.09	0.06	-0.08	0.07
156.41	-59.08	-0.35	-0.39	-0.03	-0.02	-0.06
163.11	-59.14	-0.31	0.45	-0.01	-0.00	0.00
170.00	-58.87	-0.08	-0.66	-0.44	-0.44	-0.03
190.00	-55.24	2.73	-0.33	-0.05	0.00	-0.05
210.00	-56.39	-3.03	-0.00	-0.08	-0.02	-0.06
230.00	-57.96	3.28	0.26	-0.08	0.01	-0.04
250.00	-59.92	-3.42	-0.47	-0.09	-0.01	-0.04
270.00	-61.86	3.50	-0.07	-0.12	0.00	0.08
290.00	-64.00	-3.55	-0.11	-0.10	-0.00	-0.04
310.00	-66.26	3.59	-0.67	-0.12	0.00	-0.04
330.00	-68.51	-3.63	-0.33	-0.11	-0.00	-0.08
350.00	-70.97	3.65	-0.22	-0.12	0.00	-0.05
370.00	-73.39	-3.67	-0.22	-0.12	-0.00	-0.07
390.00	-75.85	3.68	0.30	-0.13	0.00	-0.04
410.00	-78.53	-3.69	-0.53	-0.13	-0.00	-0.04
430.00	-81.13	3.69	-0.05	-0.13	0.00	0.06
450.00	-83.83	-3.69	-0.20	-0.14	-0.00	-0.05
2) 454.75	-84.48	3.69	-0.05	-0.14	-0.00	-0.05
470.00	-86.91	-3.81	-0.74	-0.14	-0.00	-0.06
490.00	-89.23	3.63	0.29	-0.08	-0.01	0.05
510.00	-92.24	-3.52	-0.02	-0.18	-0.00	-0.05
530.00	-95.57	3.52	-0.45	-0.16	0.00	0.06
550.00	-98.63	-3.54	-0.54	-0.14	-0.00	-0.06
570.00	101.32	3.52	-0.69	-0.14	-0.00	-0.06
590.00	104.56	-3.39	-0.26	-0.70	-0.08	-0.11
610.00	105.88	3.37	-0.20	0.02	0.00	-0.04
3) 614.63	105.37	-3.37	-0.36	-0.00	-0.00	-0.03
4) 624.63	105.86	3.36	-0.69	0.00	-0.00	-0.03

- 1) 90% Thrust
- 2) Mixture Ratio Shift
- 3) Guidance Cutoff
- 4) Orbit Insertion

S-IVB POWERED FLIGHT TABLES

	TIME	CHIP	CHIY	CHIR	LONG	DECL	LATT
	(SEC)	(DEG)	(DEG)	(DEG)	(DEG)	(DEG)	(DEG)
	1) 149.41	-59.32	0.00	0.00	-79.88	-28.56	-28.72
	150.00	-59.32	0.00	0.00	-79.87	28.56	28.72
	156.41	-59.32	0.00	0.00	-79.76	-28.59	-28.75
	163.11	-59.32	0.00	0.00	-79.65	28.62	28.78
	170.00	-57.57	-1.75	0.00	-79.63	-28.65	-28.81
	190.00	-55.40	3.11	0.00	-79.17	28.75	28.91
	210.00	-56.61	-3.45	0.00	-78.79	-28.85	-29.01
	230.00	-58.18	3.69	0.00	-78.38	28.96	29.12
	250.00	-60.15	-3.84	0.00	-77.94	-29.07	-29.23
	270.00	-62.14	3.93	0.00	-77.47	29.18	29.34
	290.00	-64.25	-4.00	0.00	-76.97	-29.29	-29.45
	310.00	-66.55	4.05	0.00	-76.44	29.41	29.57
	330.00	-68.79	-4.09	0.00	-75.87	-29.53	-29.70
	350.00	-71.22	4.13	0.00	-75.27	29.66	29.82
	370.00	-73.65	-4.16	0.00	-74.62	-29.79	-29.95
	390.00	-76.12	4.19	0.00	-73.92	29.92	30.08
115	410.00	-78.81	-4.21	0.00	-73.18	-30.05	-30.21
	430.00	-81.42	4.23	0.00	-72.38	30.19	30.35
	450.00	-84.13	-4.24	0.00	-71.52	-30.33	-30.49
	2) 454.75	-84.78	4.24	0.00	-71.30	30.36	30.52
	470.00	-87.21	-4.37	0.00	-70.60	-30.47	-30.63
	490.00	-89.46	4.19	0.00	-69.62	30.60	30.77
	510.00	-92.54	-4.10	0.00	-68.59	-30.74	-30.90
	530.00	-95.90	4.12	0.00	-67.49	30.87	31.04
	550.00	-98.85	-4.14	0.00	-66.33	-31.00	-31.16
	570.00	-101.64	4.13	0.00	-65.08	31.12	31.29
	590.00	-105.65	-3.93	0.00	-63.75	-31.24	-31.40
	610.00	-106.03	4.01	0.00	-62.33	31.34	31.51
	3) 614.63	-106.03	-4.01	0.00	-61.99	-31.37	-31.53
	4) 624.63	-106.03	4.01	0.00	-61.24	31.41	31.58
	1) 90% Thrust						
	2) Mixture Ratio Shift						
	3) Guidance Cutoff						
	4) Orbit Insertion						

TABLE 3C

S-IVB POWERED FLIGHT TABLES

TIME	MACH	DRAG	ALP	QQQ	YR	TACEL
(SEC)	(U)	(LB)	(DEG)	(LB/FT ²)	(FT/S)	(FT/S ²)
1) 149.41	6.52	257.	1.41	5.	6440.08	19.85
150.00	6.54	239.	1.59	5.	6442.61	20.79
156.41	6.88	105.	2.97	2.	6490.55	24.23
163.11	7.26	43.	4.41	1.	6553.17	24.55
170.00	7.50	17.	6.18	0.	6629.41	25.64
190.00	6.90	2.	13.67	0.	6878.72	26.56
210.00	5.78	0.	16.00	0.	7175.22	27.74
230.00	4.53	0.	17.64	0.	7518.84	28.90
250.00	4.02	0.	18.67	0.	7909.75	30.07
270.00	3.85	0.	19.42	0.	8347.09	31.58
290.00	3.88	0.	19.75	0.	8832.19	32.96
310.00	4.00	0.	19.77	0.	9366.82	34.78
330.00	4.16	0.	19.57	0.	9950.73	36.45
350.00	4.35	0.	19.02	0.	10588.67	38.66
370.00	4.58	0.	18.35	0.	11282.80	40.87
390.00	4.84	0.	17.48	0.	12036.31	43.46
410.00	5.13	0.	16.31	0.	12858.17	46.43
430.00	5.45	0.	15.09	0.	13751.87	49.78
450.00	5.80	0.	13.69	0.	14728.10	53.83
2) 454.75	5.89	0.	13.34	0.	14973.65	54.86
470.00	6.12	0.	12.03	0.	15624.46	44.57
490.00	6.44	0.	11.11	0.	16512.27	47.63
510.00	6.79	0.	9.44	0.	17471.82	51.13
530.00	7.18	0.	7.46	0.	18515.45	55.18
550.00	7.62	0.	5.81	0.	19653.61	59.93
570.00	8.10	0.	4.35	0.	20900.18	65.57
590.00	8.63	0.	2.39	0.	22273.89	72.35
610.00	9.22	0.	2.40	0.	23800.44	80.63
3) 614.63	9.37	0.	2.69	0.	24178.64	82.81
4) 624.63	9.38	0.	3.36	0.	24200.71	0.00

1) 90% Thrust

2) Mixture Ratio Shift

3) Guidance Cutoff

4) Orbit Insertion

MARSHALL SPACE FLIGHT CENTER

TABLE 4C
ORBITAL FLIGHT LISTING
VTH*

TIME (SEC.)	ALT (FT)	RRR (FT)	ORBITAL FLIGHT LISTING VTH* (DEG)	VVV* (FT/S)	AZ* (DEG)
53	747871.	21654485.	90.03	25549.22	86.31
830.00	750149.	21656916.	89.94	25550.82	94.84
1030.00	755282.	21664262.	89.89	25543.40	102.68
1230.00	763324.	21676565.	89.85	25531.59	109.44
1430.00	774347.	21691572.	89.81	25515.83	114.75
1630.00	788357.	21709810.	89.78	25496.74	118.52
1830.00	805161.	21729068.	89.77	25475.13	120.81
2030.00	824248.	21749979.	89.77	25452.01	121.64
2230.00	844734.	21769003.	89.79	25428.57	121.06
2430.00	865381.	21787499.	89.81	25406.16	119.06
2630.00	884691.	21802767.	89.85	25386.13	115.59
2830.00	901174.	21814688.	89.89	25369.80	110.62
3030.00	913152.	21822731.	89.93	25358.28	104.24
3230.00	919459.	21826564.	89.98	25352.40	96.70
3430.00	919610.	21826044.	90.03	25352.64	88.57
3630.00	913406.	21821215.	90.08	25359.00	80.56
3830.00	901361.	21812302.	90.12	25371.07	73.37
4030.00	884529.	21799699.	90.16	25388.06	67.46
4230.00	864373.	21783971.	90.19	25408.80	63.02
4430.00	842678.	21765855.	90.21	25431.95	60.07
4630.00	820829.	21746241.	90.23	25456.04	58.57
4830.00	800671.	21726139.	90.22	25479.62	58.50
5030.00	783026.	21706623.	90.21	25501.41	59.84
5230.00	768814.	21688037.	90.19	25520.30	62.65
5430.00	758253.	21673836.	90.15	25535.45	66.99
5630.00	751321.	21662568.	90.10	25546.25	72.85
5666.80	750373.	21660912.	90.09	25547.78	74.09
5830.00	748245.	21656208.	90.03	25571.32	80.07
6030.00	750797.	21657252.	89.95	25573.82	88.18
6230.00	758970.	21666025.	89.87	25565.24	96.46
6387.80	769203.	21678146.	89.81	25553.77	102.59
6430.00	772490.	21682118.	89.79	25549.67	104.13
6630.00	791389.	21704692.	89.73	25526.40	110.61
6830.00	813126.	21731234.	89.68	25497.82	115.62
7030.00	838720.	21760882.	89.66	25465.37	119.09
7230.00	867046.	21791941.	89.65	25430.55	121.08
7430.00	896921.	21822050.	89.66	25395.25	121.64
7630.00	926834.	21851335.	89.69	25361.15	120.80
7830.00	955002.	21876490.	89.74	25330.32	118.56

MARSHALL SPACE FLIGHT CENTER

TABLE 4C

ORBITAL FLIGHT LISTING

TIME (SEC)	ALT (FT)	RRR (FT)	VTH* (DEG)	VVV* (FT/S)	AZ* (DEG)
8030.00	979523.	21896861.	89.80	25304.43	114.87
8430.00	1010476.	21919662.	89.95	25273.60	103.16
8630.00	1014212.	21921096.	90.02	25270.70	95.55
8830.00	1019247.	21915750.	90.10	25276.65	87.45
9030.00	995785.	21903913.	90.17	25291.28	79.57
9230.00	974742.	21886161.	90.23	25313.63	72.55
9430.00	947673.	21863373.	90.28	25342.42	66.86
9630.00	916563.	21836632.	90.32	25375.86	62.61
9830.00	883669.	21807268.	90.34	25412.01	59.84
10030.00	851223.	21776749.	90.34	25448.66	58.50
10230.00	821268.	21746687.	90.33	25483.72	58.57
10495.00	88136.	21710357.	90.28	25524.49	60.87
10495.00	88136.	21710357.	90.28	25524.49	60.87
10630.00	74868.	21694446.	90.25	25541.67	63.04
10830.00	60183.	21675288.	90.18	25561.64	67.54
11030.00	51596.	21662425.	90.11	25574.35	73.57
11230.00	48981.	21656686.	90.02	25579.32	80.91
11430.00	52049.	21658466.	89.94	25576.46	89.07
11630.00	60446.	21667689.	89.86	25566.03	97.32
11840.00	74609.	21684788.	89.78	25547.54	105.24
12032.00	91988.	21716110.	89.72	25524.66	111.28
12240.00	15130.	21733929.	89.68	25494.61	116.26
12432.00	839692.	21762458.	89.66	25463.28	119.40
12640.00	869472.	21794634.	89.65	25427.09	121.26
12832.00	898164.	21823854.	89.67	25393.29	121.61
13040.00	929114.	21853245.	89.70	25358.21	120.54
13232.00	935848.	21876890.	89.75	25329.04	118.20
13440.00	980802.	21897436.	89.81	25302.79	114.15
13632.00	998401.	21910635.	89.88	25284.98	109.00
13840.00	1019946.	21918654.	89.95	25273.90	102.01
14032.00	1012671.	21919404.	90.03	25271.96	94.61
14240.00	1006582.	21913213.	90.11	25279.08	86.17
14432.00	992888.	21901328.	90.17	25293.82	78.68
14640.00	970357.	21882412.	90.24	25317.71	71.57
14832.00	943960.	21860193.	90.28	25345.77	66.28
15040.00	911440.	21832149.	90.32	25380.80	62.07
15232.00	879931.	21803655.	90.34	25415.50	59.60
15440.00	846521.	21772169.	90.34	25453.38	58.42
15632.00	818223.	21743489.	90.33	25486.67	58.67
15840.00	791978.	21714764.	90.29	25518.90	60.44
16032.00	772831.	21691901.	90.24	25543.61	63.49
16240.00	758197.	21672531.	90.17	25563.66	68.40
16432.00	750476.	21660858.	90.10	25575.18	74.38
2) 16814.80	751076.	21657486.	89.94	25576.87	89.35

- 1) S-IVB/CSM Separation
- 2) End of Nominal TV Liftoff

MARSHALL SPACE FLIGHT CENTER

TABLE 4C
ORBITAL FLIGHT LISTING

	TIME (SEC)	MASS (LB)	THRUST (LB)	VME (DEG)	AZI (DEG)	VVVE (FT/S)
	624.63	67617.40	0.	90.00	80.11	24204.52
	830.00	67149.87	0.	89.94	95.11	24206.08
	1030.00	66971.36	0.	89.89	103.40	24199.89
	1230.00	66843.64	0.	89.84	110.56	24190.23
	1430.00	66747.31	0.	89.80	116.23	24176.96
	1630.00	66672.30	0.	89.77	120.27	24160.00
	1830.00	66609.30	0.	89.76	122.72	24139.53
	2030.00	66590.53	0.	89.76	123.61	24116.13
	2230.00	66586.59	0.	89.77	122.99	24090.85
	2430.00	66582.65	0.	89.80	120.64	24065.23
	2630.00	66578.71	0.	89.84	117.13	24041.14
	2830.00	66574.76	0.	89.88	111.84	24020.60
	3030.00	66570.82	0.	89.93	105.06	24005.52
	3230.00	66566.88	0.	89.98	97.08	23997.40
	3430.00	66443.52	0.	90.03	88.48	23997.14
	3630.00	66375.53	0.	90.08	80.02	24004.87
	3830.00	66369.53	0.	90.13	72.41	24019.95
	4030.00	66363.53	0.	90.17	66.12	24040.99
	4230.00	66357.52	0.	90.20	61.38	24066.14
	4430.00	66351.52	0.	90.23	58.22	24093.23
	4630.00	66345.52	0.	90.24	56.62	24120.14
	4830.00	66339.52	0.	90.24	56.53	24145.02
	5030.00	66333.52	0.	90.22	57.98	24166.50
	5230.00	66327.52	0.	90.20	61.00	24183.73
	5430.00	66321.52	0.	90.16	65.64	24196.40
	5630.00	66315.52	0.	90.11	71.87	24204.62
1)	5666.80	66314.41	0.	90.10	73.18	24205.67
	5830.00	64647.95	75.	90.03	79.51	24227.53
	6030.00	64411.04	18.	89.94	88.68	24228.81
	6230.00	64277.26	10.	89.86	96.82	24220.15
2)	6387.80	64207.25	20.	89.79	103.30	24209.38
	6430.00	64206.06	0.	89.78	104.93	24205.56
	6630.00	64203.41	0.	89.71	111.81	24183.95
	6830.00	64194.77	0.	89.66	117.15	24157.21
	7030.00	64189.13	0.	89.64	120.88	24126.08
	7230.00	64183.48	0.	89.63	123.01	24091.55
	7430.00	64177.84	0.	89.64	123.62	24055.00
	7630.00	64172.20	0.	89.68	122.73	24018.26
	7830.00	64166.55	0.	89.73	120.33	23983.51

- 1) Begin LOX Dump
2) End LOX Dump

MARSHALL SPACE FLIGHT CENTER

TABLE 4C

ORBITAL FLIGHT LISTING

	TIME (SEC)	MASS (LB)	THRUST (LB)	VELOCITY (DEG)	AZI (DEG)	VELOCITY (FT/S)
	8030.00	64160.91	0.	89.79	116.37	23953.12
	8430.00	64149.62	0.	89.94	103.92	23914.46
	8630.00	64143.98	0.	90.12	95.87	23909.66
	8830.00	64138.34	0.	90.10	87.31	23915.68
	9030.00	64132.70	0.	90.18	78.97	23932.28
	9230.00	64127.08	0.	90.24	71.55	23958.34
	9430.00	64121.46	0.	90.30	63.47	23991.88
	9630.00	64115.83	0.	90.34	55.94	24030.39
	9830.00	64110.21	0.	90.36	57.96	24071.04
	10030.00	64104.59	0.	90.36	56.53	24111.01
	10230.00	64098.97	0.	90.35	56.61	24147.79
1)	10495.00	64091.52	0.	90.30	59.09	24188.29
	10495.00	31333.52	0.	90.30	59.09	24188.29
	10630.00	31232.03	0.	90.26	61.41	24204.41
	10830.00	31224.03	0.	90.19	66.23	24227.13
	11030.00	31216.03	0.	90.11	72.63	24232.36
	11230.00	31208.03	0.	90.12	80.40	24235.30
	11430.00	31200.03	0.	89.93	89.02	24231.35
	11630.00	31192.03	0.	89.85	97.73	24220.99
	11840.00	31183.63	0.	89.77	106.10	24203.68
	12032.00	31175.95	0.	89.71	112.52	24182.52
	12240.00	31167.63	0.	89.66	117.84	24154.37
	12432.00	31159.95	0.	89.64	121.21	24124.21
	12640.00	31151.63	0.	89.63	123.21	24088.09
	12832.00	31143.95	0.	89.65	123.60	24052.94
	13040.00	31135.63	0.	89.68	122.45	24014.88
	13232.00	31127.95	0.	89.73	119.94	23981.86
	13440.00	31119.63	0.	89.80	115.61	23950.90
	13632.00	31111.95	0.	89.87	111.12	23929.95
	13840.00	31103.63	0.	89.95	102.71	23914.45
	14032.00	31095.95	0.	90.03	94.87	23910.90
	14240.00	31087.63	0.	90.11	85.95	23918.32
	14432.00	31079.95	0.	90.18	78.03	23935.24
	14640.00	31071.63	0.	90.25	70.49	23963.14
	14832.00	31063.95	0.	90.30	64.85	23995.85
	15040.00	31055.63	0.	90.34	60.36	24036.08
	15232.00	31047.95	0.	90.35	57.71	24074.98
	15440.00	31039.63	0.	90.36	56.44	24116.11
	15632.00	31031.95	0.	90.34	56.72	24150.81
	15840.00	31023.63	0.	90.31	58.62	24182.87
	16032.00	31015.95	0.	90.25	61.90	24206.12
	16240.00	31007.63	0.	90.18	67.14	24223.76
	16432.00	30999.95	0.	90.10	73.49	24232.94
2)	16814.80	30984.64	0.	89.94	89.31	24231.81

1) S-IVB/CSM Separation

2) End of Nominal IU Lifetime

MARSHALL SPACE FLIGHT CENTER

TABLE 4C
ORBITAL FLIGHT LISTING

TIME				CX	CY	CZ
(SEC)	(FT)	(FT)	(FT)	(FT/S)	(FT/S)	(FT/S)
024.63	21449802.	488243.	710921.	-8402.99	1348.19	24090.15
830.00	10145536.	749104.	11798322.	-13926.66	1179.73	21289.27
1030.00	14885168.	903001.	15711291.	-18925.76	949.31	17560.19
1230.00	13873710.	1125005.	18798074.	-22099.66	666.15	12766.07
1430.00	6126865.	1226971.	20772106.	-24452.51	345.71	7261.02
1630.00	1112702.	1262268.	21644502.	-25458.01	5.50	1404.92
1830.00	-3962998.	1229092.	21229849.	-25066.06	-325.88	-4524.53
2030.00	-8822261.	1129080.	19848287.	-23304.75	-659.82	-10210.67
2230.00	-1327345.	907902.	17263810.	-20277.53	-948.76	-15214.50
2430.00	-10860187.	752955.	13779052.	-16155.99	-1187.12	-19571.00
2630.00	-19674943.	496884.	9526800.	-11168.93	-1362.15	-22756.43
2830.00	-21288154.	212946.	4709170.	-5588.81	-1464.54	-24703.18
3030.00	-21820959.	-83714.	-265160.	282.41	-1468.80	-25212.95
3230.00	-21176237.	-377261.	-5274800.	0133.95	-1423.52	-24857.36
3430.00	-19389591.	-651987.	-9999743.	11051.85	-1301.27	-22078.81
3630.00	-10557291.	-893113.	-14185342.	16543.87	-1098.94	-19187.79
3830.00	-12831295.	-1087353.	-17605444.	20546.59	-826.49	-14857.56
4030.00	-0411579.	-1224595.	-20074177.	23449.31	-527.45	-9716.22
4230.00	-0536022.	-1296490.	-21455933.	25185.46	-187.87	-4026.31
4430.00	1531799.	-1298895.	-21673999.	25361.97	164.26	1878.12
4630.00	0516430.	1231161.	-20710366.	24256.01	510.25	7706.84
4830.00	11145366.	1096429.	-18617287.	21820.05	821.25	13130.54
5030.00	15164373.	-901524.	-15505342.	18180.84	1109.26	17847.92
5230.00	16350372.	-656033.	-11543891.	13533.77	1328.72	21995.31
5430.00	0527200.	-374786.	-6946134.	8132.59	1477.02	24160.69
5630.00	21572936.	-71160.	-1967290.	2275.26	1545.41	25397.79
5830.00	21636360.	-14205.	-1030937.	1172.48	1548.88	25473.77
6030.00	21428551.	237965.	3122810.	-3710.70	1530.77	25254.30
6230.00	2111394.	535625.	8042613.	-9495.98	1421.25	23702.28
6430.00	17664807.	805356.	12518891.	-14753.22	1252.79	20841.17
6630.00	15046253.	988633.	15574817.	-16335.73	1062.64	17767.02
6830.00	14254214.	103292.	16305397.	-15190.57	1005.28	16827.27
7030.00	10959099.	1203929.	19195279.	-22562.69	702.34	11917.59
7230.00	5311990.	1310730.	21031158.	-24689.28	360.70	6359.51
7430.00	273870.	1346881.	21717423.	-25460.95	-0.89	474.60
7630.00	-4779710.	1310361.	21220885.	-24645.04	-362.70	-5412.69
7830.00	-9574437.	1203094.	19573216.	-22885.83	-705.18	-10584.54
8030.00	-13862134.	1030003.	16808216.	-19499.90	-1010.04	-15940.00
8230.00	-17384530.	802666.	13255742.	-15467.62	-1761.19	-20019.67

MARSHALL SPACE FLIGHT CENTER

TABLE 4C
ORBITAL FLIGHT LISTING

TIME (SEC)	(FT)	(FT)	Z : (FT)	CX (FT/S)	DY (FT/S)	CZ (FT/S)
8030.00	-19984845.	530790.	8932904.	-10421.54	1445.54	-23013.39
8430.00	-21901549.	-85158.	-886831.	1002.48	1579.63	-25204.26
8630.00	-21119856.	-396732.	-5859372.	6779.27	1522.32	-24296.76
8830.00	-19213879.	-688691.	-10519157.	12196.23	1384.27	-22096.31
9030.00	-10284315.	-945495.	-14618770.	16970.09	1172.19	-18716.05
9230.00	-12485638.	1153319.	-17938304.	20848.45	-896.52	-14328.54
9430.00	-3018713.	1309775.	-20298160.	23621.89	-571.05	-9160.69
9630.00	-3121133.	1379522.	-21568377.	25135.18	-212.40	-3480.37
9830.00	1945090.	-1384765.	-21676162.	25296.81	160.75	2411.64
10030.00	8916037.	-1315581.	-20617742.	24086.17	528.53	8198.26
10230.00	11491516.	-1175450.	-18425756.	21557.42	870.89	13562.42
10430.00	10563054.	-691444.	-14007504.	16405.77	1253.11	19513.59
10630.00	18563912.	-711039.	-11208708.	13129.01	1405.26	21863.92
10830.00	20652556.	-413119.	-6568111.	7083.94	1566.58	24329.00
11030.00	21615531.	-90071.	-1566375.	1800.40	1643.12	25457.57
11230.00	21367184.	238149.	3521197.	-4178.38	1630.01	25182.04
11430.00	19949541.	535361.	8414068.	-9932.21	1527.50	23519.64
11630.00	17431163.	843536.	12842576.	-15134.26	1340.95	20561.57
11830.00	13756102.	1097038.	16727371.	-19680.84	1065.81	16247.13
12030.00	9659598.	1273288.	19396549.	-22802.81	757.13	11444.09
12230.00	4677181.	1392134.	21173990.	-24866.13	379.92	5613.09
12430.00	-174919.	1429832.	21714732.	-25463.22	11.39	-52.53
12630.00	-5414327.	1390567.	21165505.	-24667.98	-388.73	-6154.40
12830.00	-9976026.	1281721.	1936793.	-22652.36	-738.33	-11451.84
13030.00	-14350961.	1092167.	16444498.	-19211.08	1075.48	-16517.17
13230.00	-17653526.	800136.	12892307.	-15050.39	1332.11	-20329.08
13430.00	-20242657.	500334.	8331782.	-9727.16	1536.29	-23207.80
13630.00	-21596632.	253486.	3688625.	-4320.60	1647.01	-24858.60
13830.00	-21804411.	-93809.	-1530229.	1756.81	1676.40	-25156.97
14030.00	-20993233.	-411412.	-6297867.	7280.41	1618.44	-24146.40
14230.00	-18869125.	-733795.	-11083330.	12854.65	1466.44	-21717.26
14430.00	-13977035.	-993709.	-14946943.	17356.14	1250.49	-18356.96
14630.00	-11940214.	-1225516.	-18296717.	21273.43	-946.30	-13694.25
14830.00	-7594305.	-1375017.	-20452425.	23813.56	-614.57	-8665.33
15030.00	-2408805.	-1462952.	-21642724.	25233.70	-218.64	-2715.90
15230.00	2397394.	-1468485.	-21021845.	25244.32	161.76	2940.36
15430.00	7526584.	-1392309.	-20382330.	23831.04	567.73	8922.80
15630.00	11874795.	-1249259.	-18171025.	21270.45	916.62	14010.64
15830.00	10904254.	-1023501.	-14749184.	17279.64	245.23	18737.06
16030.00	18791545.	-760084.	-10809193.	12666.62	485.97	22131.59
16230.00	20840991.	-430916.	-5930276.	6939.16	663.63	24547.53
16430.00	21632325.	-102070.	-1106700.	1267.66	741.22	25484.32
16630.00	19941127.	554002.	8431529.	-9953.80	634.29	23503.77

- 1) S-IVB/CSM Separation
2) End of Nominal IU Lifetime

MARSHALL SPACE FLIGHT CENTER

TABLE 4C
ORBITAL FLIGHT LISTING

TIME (SEC)	XE (FT)	YE (FT)	ZE (FT)	OXE (FT/S)	OYE (FT/S)	OZE (FT/S)
624.63	-197242.	322736.	6324103.	-7763.94	1787.69	23082.59
830.00	-2175593.	717393.	10855830.	-12119.64	2038.41	20854.10
1030.00	-3042952.	1140120.	14720349.	-16434.22	2167.47	17631.03
1230.00	-8694609.	1575.17.	17850217.	-19930.17	2156.35	13535.05
1430.00	-12948881.	1992115.	20091890.	-22435.78	1987.42	8786.98
1630.00	-17594735.	2358989.	21337052.	-23830.51	1653.97	3616.19
1830.00	-224.2647.	2643056.	21527827.	-24050.69	1161.24	-1712.53
2030.00	-27136292.	2814005.	20659281.	-23092.09	.526.69	-6932.95
2230.00	-31564389.	2846188.	18779097.	-21008.98	-220.70	-11787.41
2430.00	-35472055.	2720785.	15984530.	-17910.12	-1041.93	-16039.86
2630.00	-36671054.	2427006.	12416930.	-13951.90	-1890.14	-19487.13
2830.00	-41008473.	1966394.	8254231.	-9329.57	-2713.32	-21967.85
3030.00	-42373498.	1347554.	3701902.	-4267.17	-3457.41	-23368.84
3230.00	-42702124.	592248.	-1017114.	993.14	-4069.43	-23628.98
3430.00	-41979680.	-268152.	-5673001.	6201.76	-4500.77	-22740.80
3630.00	-41241319.	-1193250.	-10039802.	11112.18	-4711.33	-20750.09
3830.00	-37570287.	-2135421.	-15905876.	15491.20	-4667.41	-17753.76
4030.00	-34094335.	-3042167.	-17083765.	19128.82	-4354.33	-13895.94
4230.00	-29960091.	-5858929.	-19419103.	21347.75	-3768.49	-9362.34
4430.00	-25425648.	-4532257.	-20793207.	23512.04	-2923.71	-4372.58
4630.00	-20651500.	-5013157.	-21153933.	24034.73	-1850.73	829.35
4830.00	-15890143.	-5260427.	-20469415.	23383.48	-596.52	5986.60
5030.00	-11374799.	-5243744.	-18779392.	21583.77	777.50	10642.33
5230.00	-7327764.	-4946271.	-16168843.	18718.98	2198.48	15153.19
5430.00	-3949118.	-4366561.	-12708932.	14927.09	3586.09	18702.62
5630.00	-1416418.	-3519090.	-8750488.	10394.09	4857.30	21312.74
5830.00	-104.357.	-3336821.	-7959141.	9496.58	5072.05	21679.57
6030.00	175177.	-2435988.	-4312175.	5353.60	5935.87	22870.89
6230.00	717036.	-1162856.	327886.	40.82	6741.01	23272.14
6430.00	172021.	238993.	4923679.	-5270.22	7214.45	22512.05
6630.00	-959190.	1389672.	8374423.	-9284.17	7325.69	21124.22
6830.00	-1372720.	1698715.	9256107.	-10312.91	7314.07	20641.15
7030.00	-3897968.	3138886.	13113420.	-14835.76	7016.97	17762.05
7230.00	-7257328.	4479426.	16305840.	-18018.00	6323.43	14034.07
7430.00	-11283568.	5643328.	13683404.	-21478.07	5256.40	9650.41
7630.00	-15778076.	6560050.	20137400.	-23282.89	3860.83	4837.76
7830.00	-2520978.	7170039.	20606090.	-23953.52	2201.32	-161.56
8030.00	-25282240.	7428355.	20076782.	-23467.47	358.72	-5101.58
8230.00	-29832931.	7307492.	18585291.	-21857.78	-1574.26	-9745.15

MARSHALL SPACE FLIGHT CENTER

TABLE 4C

ORBITAL FLIGHT LISTING

TIME (S:G)	XF (FT)	YE (FT)	ZE (FT)	DXE (FT/S)	DYE (FT/S)	DZE (FT/S)
8030.00	-35955994.	6799279.	16213562.	-19209.45	-3497.86	-13874.95
8031.00	-43168249.	4689161.	9349104.	-11367.81	-6912.92	-19875.74
8630.00	-41964661.	3170705.	5196442.	-6532.15	-8214.52	-21483.12
8850.00	-42707280.	1428732.	824931.	-1391.65	-9136.19	-22057.95
9030.00	-42516358.	-454273.	-3536398.	3822.92	-9615.22	-21579.78
9230.00	-4124233.	-2384932.	-773522.	8969.08	-9608.82	-20075.16
9430.00	-33995824.	-4263993.	-11522777.	13509.10	-9097.27	-17616.87
9630.00	-35880579.	-5990496.	-14729400.	17523.06	-8086.45	-14321.89
9830.00	-32043001.	-7467420.	-17206150.	20704.20	-6609.22	-10347.42
10030.00	-27655041.	-8607035.	-19835780.	22899.28	-4725.59	-5884.54
10230.00	-22957150.	-9336214.	-19542167.	-13988.18	-2521.11	-1151.95
1) 10495.00	-16672425.	-9531637.	-19009760.	23625.88	707.65	5137.16
10495.00	-16672425.	-9531637.	-19009760.	23625.88	707.65	5137.18
10630.00	-13472917.	-9371701.	-18107014.	22649.95	2472.51	8169.37
10830.00	-9102820.	-8643118.	-16046825.	20272.11	4862.09	12332.41
11030.00	-5431313.	-7439118.	-13216885.	16887.56	7138.06	15845.05
11230.00	-2463867.	-5809105.	-970252.	12663.39	9099.30	18552.29
11430.00	-477895.	-3828223.	-5858255.	7811.21	10628.94	20226.57
11630.00	654997.	-1592717.	-1699499.	2575.36	11631.79	21088.51
11840.00	585105.	905229.	2715755.	-3146.66	1244.47	20771.78
12032.00	-483337.	3205039.	6597115.	-8038.61	11814.13	19509.01
12240.00	-2632869.	5579921.	10428308.	-13013.94	10909.81	17176.93
12432.00	-5573930.	7547985.	13456829.	-16985.22	9503.83	14253.21
12640.00	-9479998.	9318512.	16033365.	-20494.88	7433.35	10422.20
12832.00	-13624237.	10328044.	17659502.	-22601.09	5108.51	6452.73
13040.00	-18474592.	11299017.	18529826.	-23831.85	2268.39	1900.51
13232.00	-23070315.	11409116.	18487166.	-23862.37	-520.38	-2232.67
13440.00	-27934403.	11043709.	17538311.	-22705.04	-3568.12	-6737.58
13632.00	-32106474.	10096158.	15881762.	-20594.51	-6264.78	-10450.92
13840.00	-30063703.	8311932.	13336471.	-17292.10	-8907.56	-13911.84
14032.00	-39025763.	6597493.	10410604.	-13449.14	-10963.50	-16451.55
14240.00	-41331191.	4130766.	6772941.	-8021.70	-12652.66	-18375.60
14432.00	-42524757.	1598416.	3141222.	-3756.46	-13626.26	-19316.04
14640.00	-42738246.	-1285403.	-901347.	1708.92	-13976.48	-19389.94
14832.00	-41928339.	-9444906.	-4560387.	8099.41	-13616.30	-18588.03
15040.00	-39997928.	-6672625.	-8259531.	11784.82	-12405.48	-16821.53
15232.00	-37325030.	-6916042.	-11270371.	15956.57	-10792.64	-14435.93
15440.00	-33002565.	-10916303.	-1394578.	19680.92.	-8333.15	-11171.68
15632.00	-29565844.	-12259083.	-15759489.	22210.63	-5588.31	-7662.93
15840.00	-24757263.	-13079188.	-16926513.	23820.20	-2247.61	-3515.33
16032.00	-20131541.	-13198543.	-17221445.	24180.45	1020.05	449.24
16240.00	-15168751.	-12615595.	-16685009.	23323.79	4570.70	4679.77
16432.00	-10857099.	-11435282.	-15430033.	21416.44	7683.65	8338.64
16814.80	-3815727.	-7457560.	-11029742.	14809.53	12791.24	14291.35

- 1) S-IVB/CSM Separation
2) End of Nominal IU Lifetime

MARSHALL SPACE FLIGHT CENTER

TABLE 4C

ORBITAL FLIGHT LISTING

TIME	PHIP	PHIY	PHIR	LONG	DECL	LATT
(SEC)	(DEG)	(DEG)	(DEG)	(DEG)	(DEG)	(DEG)
024.63	-175.86	3.36	-0.09	-61.24	31.41	1.58
030.00	-123.12	2.04	-1.98	-45.83	31.27	1.44
1030.00	-136.64	2.13	-2.55	-31.19	29.20	9.36
1230.00	-153.14	1.49	-2.9	-17.42	25.44	5.58
1430.00	-163.61	3.77	-3.2	-4.68	20.34	0.46
1630.00	-177.06	-1.30	-3.3	7.09	14.28	4.36
1830.00	169.32	-0.77	-3.2	13.14	7.59	7.64
2030.00	156.11	-1.50	-2.9	28.81	0.61	0.62
2230.00	142.73	-2.15	-2.5	39.42	-6.38	6.42
2430.00	129.35	-2.68	-1.9	50.32	-13.10	3.18
2630.00	115.99	-3.08	-1.3	61.84	-19.25	9.37
2830.00	102.63	-3.31	-0.3	74.22	-24.51	4.65
3030.00	89.29	-3.37	0.2	87.59	-28.53	8.68
3230.00	75.90	-3.24	0.9	101.84	-30.96	1.12
3430.00	62.63	-2.94	1.7	116.57	-31.58	1.74
3630.00	49.31	-2.49	2.3	131.29	-30.31	0.47
3830.00	35.99	-1.90	2.8	145.18	-27.28	7.43
4030.00	22.67	-1.20	3.2	158.22	-22.79	2.92
4230.00	9.33	-0.44	3.4	170.29	-17.17	7.27
4430.00	-4.02	0.36	3.4	-178.43	-10.77	2.84
4630.00	-17.40	1.14	3.2	-167.66	-3.91	2.94
4830.00	-30.81	1.86	2.7	-157.05	3.12	2.14
5030.00	-44.26	2.48	2.3	-146.26	10.04	0.10
5230.00	-57.74	2.98	1.7	-134.97	16.55	0.65
5430.00	-71.25	3.31	0.9	-122.86	22.31	0.44
5630.00	-84.78	3.47	0.1	-109.73	26.98	0.13
5830.00	-97.27	3.48	0.0	-107.20	27.68	0.84
6030.00	-98.33	3.43	-0.0	-95.59	30.16	0.32
6230.00	-111.89	3.21	-1.4	-83.72	31.56	0.72
6430.00	-125.43	2.00	-2.1	-65.73	31.01	0.17
6630.00	-136.10	2.37	-2.6	-54.22	29.23	0.39
6830.00	-138.95	2.24	-2.7	-51.23	28.58	0.73
7030.00	-152.43	1.56	-3.1	-37.66	24.52	0.66
7230.00	-165.87	0.79	-3.4	-25.16	19.21	0.33
7430.00	-179.28	-0.02	-3.5	-13.58	13.12	0.10
7630.00	167.36	-0.84	-3.4	-2.67	6.28	0.32
7830.00	154.02	-1.61	-3.1	7.90	-0.69	0.69
8030.00	140.72	-2.30	-2.7	18.48	-7.62	0.66
8230.00	127.43	-2.86	-2.1	29.39	-14.22	0.30

MARSHALL SPACE FLIGHT CENTER

TABLE 4C

ORBITAL FLIGHT LISTING

TIME (SEC)	PHIP (DEG)	HIY (DEG)	PHIR (DEG)	LONG (DEG)	DECL (DEG)	LATT (DEG)
8030.00	114.16	-3.28	1.39	41.95	-20.20	-20.32
8430.00	87.07	-3.58	0.22	66.80	-29.00	-29.16
8630.00	74.43	-3.45	1.04	81.04	-31.16	-31.33
8830.00	61.20	-3.14	1.80	95.68	-31.51	-31.68
9030.00	49.80	-2.68	2.46	110.14	-30.01	-30.17
9230.00	34.73	-2.74	3.02	123.93	-26.80	-26.95
9430.00	21.48	-1.31	3.41	136.77	-22.16	-22.31
9630.00	8.21	-0.50	3.52	148.67	-16.48	-16.58
9830.00	-17.94	1.56	3.31	159.84	-10.13	-10.10
10030.00	-38.43	2.38	2.86	170.56	-3.16	-3.18
10230.00	-51.84	2.88	2.25	-178.85	3.87	3.89
10495.00	-54.53	2.99	2.11	-164.41	12.91	12.99
10495.00	-54.53	2.99	2.11	-164.41	12.91	12.99
10630.00	-54.53	2.99	2.11	-156.66	17.20	17.30
10830.00	-54.53	2.99	2.11	-144.44	22.87	22.00
11030.00	-54.53	2.99	2.11	-131.19	27.39	27.55
11230.00	-54.53	2.99	2.11	-116.94	30.40	30.56
11430.00	-54.53	2.99	2.11	-102.04	31.59	31.76
11630.00	-54.53	2.99	2.11	-87.07	30.83	31.00
11840.00	-47.13	2.38	-10.39	-71.96	28.04	28.19
12032.00	10.57	1.68	-106.39	-59.78	23.96	24.10
12240.00	12.40	0.83	-176.33	-46.21	18.29	18.40
12432.00	-0.46	0.00	-176.23	-35.21	12.25	12.33
12640.00	-14.36	0.90	-176.34	-23.92	5.19	5.23
12832.00	-27.15	1.69	-176.63	-13.79	-1.51	-1.52
13040.00	-40.99	2.45	-177.13	-2.76	-8.69	-8.74
13232.00	-53.74	3.02	-177.74	7.78	-14.96	-15.05
13440.00	-67.04	3.49	-178.53	19.92	-21.17	-21.19
13632.00	-81.26	3.74	-179.34	31.99	-25.76	-25.90
13840.00	-94.04	5.60	179.75	46.08	-29.46	-29.62
14032.00	-106.75	3.67	178.92	59.83	-31.30	-31.47
14240.00	-120.52	3.33	178.08	75.07	-31.40	-31.56
14432.00	-133.22	2.84	177.39	88.89	-29.71	-29.87
14640.00	-146.99	2.16	176.79	103.10	-26.15	-26.30
14832.00	-159.72	1.41	176.39	115.30	-21.55	-21.68
15040.00	-173.53	0.52	176.16	127.56	-15.50	-15.59
15232.00	173.70	0.34	176.14	138.20	-9.23	-9.29
15440.00	159.81	1.26	176.33	149.31	-2.04	-2.06
15632.00	146.95	2.04	176.70	159.49	4.70	4.73
15840.00	132.97	2.78	177.30	170.80	11.81	11.89
16032.00	120.02	-3.53	177.99	-178.19	17.92	18.03
16240.00	105.96	-3.73	178.86	-165.34	23.67	23.81
16432.00	92.95	-3.90	179.73	-152.48	27.84	27.99
2) 16814.80	66.99	-3.66	-178.53	-124.48	31.60	31.76

Manual control begins at 8995 and ends at 9175

- 1) S-IVB/CSM Separation
- 2) End of Nominal IU Lifetime

LANGSTON SPACE FLIGHT CENTER

TABLE 5C

S-IB STAGE REENTRY DATA

TIME	ALT	RRR	VTH*	VVV*	AZ*
(SEC)	(FT)	(FT)	(DEG)	(FT/S)	(DEG)
144.49	203396.	21113067.	63.42	7633.72	75.70
160.00	252205.	21161804.	66.62	7325.25	75.90
180.00	304564.	21214073.	70.90	7094.01	76.10
200.00	345241.	21254660.	75.44	6912.59	76.30
220.00	374287.	21283618.	80.17	6783.69	76.50
240.00	391734.	21300979.	85.05	6703.49	76.70
260.00	397600.	21306760.	90.00	6673.47	76.90
280.00	391892.	21300968.	94.96	6703.15	77.10
300.00	374604.	21283596.	99.84	6783.02	77.30
320.00	345717.	21254627.	104.57	6911.55	77.51
340.00	305202.	21214031.	109.10	7092.24	77.71
360.00	253025.	21161773.	113.39	7316.15	77.92
380.00	189314.	21097983.	117.38	7529.83	78.15
400.00	117056.	21025650.	120.60	6996.22	78.68
420.00	66614.	20975164.	116.56	2961.45	82.85
460.00	37841.	20946379.	110.53	1548.96	88.74
480.00	27815.	20936351.	108.46	1361.63	89.33
500.00	19207.	20927743.	106.49	1413.67	89.68
520.00	11671.	20920206.	104.84	1384.76	89.88
540.00	4956.	20913491.	103.49	1365.28	90.02
556.17	0.	20908535.	102.59	1355.00	90.08

MARSHALL SPACE FLIGHT CENTER

TABLE 5C
S-IB STAGE REENTRY DATA

TIME	MASS	THRUST	VTHE	AZI	RANGE	VVVE
(SEC)	(LB)	(LB)	(DEG)	(DEG)	(FT)	(FT/S)
144.49	101713.03	44478.	58.28	72.23	203242.	6493.74
160.00	100511.76	0.	61.79	72.41	286730.	6150.22
180.00	100511.76	0.	66.73	72.64	393443.	5874.12
200.00	100511.76	0.	72.09	72.87	499545.	5654.08
220.00	100511.76	0.	77.83	73.11	605205.	5492.24
240.00	100511.76	0.	83.84	73.35	710568.	5392.91
260.00	100511.76	0.	90.00	73.60	815777.	5359.13
280.00	100511.76	0.	96.16	73.86	920976.	5391.96
300.00	100511.76	0.	102.18	74.12	1026306.	5490.36
320.00	100511.76	0.	107.92	74.39	1131910.	5651.30
340.00	100511.76	0.	113.29	74.66	1237932.	5870.13
360.00	100511.76	0.	118.24	74.94	1344500.	6138.48
380.00	100511.76	0.	122.75	75.22	1451451.	6400.46
400.00	100511.76	0.	127.03	75.50	1554519.	5914.17
420.00	100511.76	0.	134.67	75.76	1615684.	1883.67
460.00	100511.76	0.	166.89	75.40	1632705.	557.69
480.00	100511.76	0.	172.46	74.77	1634495.	466.88
500.00	100511.76	0.	175.74	75.11	1635373.	402.37
520.00	100511.76	0.	177.94	77.42	1635785.	354.85
540.00	100511.76	0.	179.65	103.75	1635922.	318.52
556.17	100511.76	0.	179.31	236.99	1635897.	295.38

TABLE 5C
S-IB STAGE REENTRY DATA

TIME (SEC)	X (FT)	Y (FT)	Z (FT)	DX (FT/S)	DY (FT/S)	DZ (FT/S)
144.49	21109331.	116829	319018.	3289.19	389.20	6874.42
160.00	21155889.	122852	485032.	2750.40	387.29	6778.24
180.00	21204598.	130569	620390.	2121.72	384.35	6758.37
200.00	21240784.	138225	755357.	1497.37	381.19	6737.69
220.00	21264507.	145815	889873.	875.27	377.83	6713.34
240.00	21275805.	153336	1023865.	254.71	374.25	6685.18
260.00	21274702.	160784	1157255.	-364.99	370.47	6653.17
280.00	21261207.	168154	1289966.	-984.47	366.47	6617.29
300.00	21235320.	175441	1421920.	-1604.38	362.26	6577.49
320.00	21197026.	182642	1553039.	-2225.37	357.82	6533.70
340.00	21146296.	189752	1683240.	-2848.01	353.15	6485.68
360.00	21083099.	196767	1812424.	-3471.35	348.25	6430.75
380.00	21007594.	203681	1940208.	-4065.52	343.15	6328.68
400.00	20923198.	210494	2062389.	-4137.79	338.34	5631.28
420.00	20864162.	217239	2144073.	-1589.21	336.58	2476.16
460.00	20828278.	230568	2209180.	-692.61	329.55	1345.72
480.00	20815317.	237143	2235437.	-607.61	328.36	1288.16
500.00	20803829.	243709	2260914.	-544.71	328.32	1262.52
520.00	20793424.	250275	2286025.	-498.12	328.28	1249.66
540.00	20783834.	256839	2310935.	-462.64	328.04	1241.91
556.17	20776541.	262142	2330986.	-440.36	327.63	1238.86

MARSHALL SPACE FLIGHT CENTER

TABLE 5C

S-IB STAGE REENTRY DATA

TIME (SEC)	XE (FT)	YE (FT)	ZE (FT)	DXE (FT/S)	DYE (FT/S)	DZE (FT/S)
144.49	292402.	-110.	205039.	3365.34	3.57	5553.66
160.00	250221.	-24.	289960.	2837.38	7.57	5456.60
180.00	300818.	183.	398885.	2223.53	13.19	5437.00
200.00	339188.	507.	507445.	1613.96	19.28	5418.80
220.00	365390.	957.	615627.	1006.53	25.83	5399.16
240.00	379459.	1543.	723401.	400.51	32.82	5377.92
260.00	381416.	2272.	830733.	-204.77	40.24	5355.06
280.00	371269.	3155.	927592.	-809.98	48.10	5330.56
300.00	349013.	4199.	1043944.	-1415.78	56.37	5304.38
320.00	314630.	5413.	1149756.	-2022.83	65.05	5276.46
340.00	268089.	6804.	1254990.	-2631.74	74.13	5246.60
360.00	209353.	8380.	1359593.	-3241.61	83.56	5212.09
380.00	138569.	10145.	1463223.	-3823.58	92.58	5132.01
400.00	59047.	12021.	1561639.	-3899.07	89.61	4445.97
420.00	4100.	13235.	1619111.	-1422.66	28.24	1234.29
460.00	-25911.	13575.	1633913.	-551.29	0.41	84.22
480.00	-26047.	13562.	1634927.	-466.19	-1.14	25.36
500.00	-44697.	13540.	1635138.	-402.37	-0.96	-1.22
520.00	-52243.	13526.	1634966.	-354.54	-0.51	-14.73
540.00	-58949.	13520.	1624584.	-317.69	-0.11	-22.94
556.17	-67000.	13520.	1634176.	-294.22	0.09	-26.22

JOHNS HOPKINS SPACE FLIGHT CENTER

TABLE 5C

S-IB STAGE REENTRY DATA

TIME	CHIP	CHIY	CHIR	LONG	DECL	LATT
(SEC)	(DEG)	(DEG)	(DEG)	(DEG)	(DEG)	(DEG)
144.49	-59.32	0.00	0.00	-79.96	28.53	28.69
160.00	-59.32	0.00	0.00	-79.71	28.60	28.76
180.00	-59.32	0.00	0.00	-79.39	28.69	28.85
200.00	-59.32	0.00	0.00	-79.08	28.78	28.94
220.00	-59.32	0.00	0.00	-78.76	28.86	29.02
240.00	-59.32	0.00	0.00	-78.44	28.94	29.11
260.00	-59.32	0.00	0.00	-78.13	29.03	29.19
280.00	-59.32	0.00	0.00	-77.81	29.11	29.27
300.00	-59.32	0.00	0.00	-77.49	29.19	29.35
320.00	-59.32	0.00	0.00	-77.18	29.27	29.43
340.00	-59.32	0.00	0.00	-76.85	29.34	29.51
360.00	-59.32	0.00	0.00	-76.53	29.42	29.58
380.00	-59.32	0.00	0.00	-76.21	29.50	29.66
400.00	-59.32	0.00	0.00	-75.89	29.57	29.73
420.00	-59.32	0.00	0.00	-75.70	29.61	29.77
460.00	-59.32	0.00	0.00	-75.65	29.62	29.79
480.00	-59.32	0.00	0.00	-75.65	29.62	29.79
500.00	-59.32	0.00	0.00	-75.64	29.62	29.79
520.00	-59.32	0.00	0.00	-75.64	29.62	29.79
540.00	-59.32	0.00	0.00	-75.64	29.62	29.79
556.17	-59.32	0.00	0.00	-75.64	29.62	29.79

MARSHALL SPACE FLIGHT CENTER

TABLE 5C

S-IB STAGE REENTRY DATA

TIME (SEC)	ACH (U)	DRAW (LB)	ALP (DEG)	QQQ (LB/FT2)	VR (FT/S)	TACEL (FT/S2)
144.49	6.36	15469.	0.00	11.	6490.39	9.00
160.00	6.65	1731.	0.00	1.	6146.75	0.55
180.00	6.49	94.	0.00	0.	5870.50	0.03
200.00	5.58	10.	0.00	0.	5650.34	0.00
220.00	4.81	2.	0.00	0.	5488.39	0.00
240.00	4.35	1.	0.00	0.	5389.00	0.00
260.00	4.15	1.	0.00	0.	5355.19	0.00
280.00	4.35	1.	0.00	0.	5388.05	0.00
300.00	4.80	2.	0.00	0.	5486.52	0.00
320.00	5.57	10.	0.00	0.	5647.55	0.00
340.00	6.48	90.	0.00	0.	5866.51	0.03
360.00	6.65	1659.	0.00	1.	6135.01	0.53
380.00	6.11	15632.	0.00	17.	6397.15	8.20
400.00	5.75	10275.	0.00	162.	5911.03	124.93
420.00	1.98	535575.	0.00	106.	1888.92	171.44
460.00	0.56	115209.	0.00	03.	548.04	36.91
480.00	0.45	111464.	-0.00	04.	463.72	35.68
500.00	0.38	108548.	-0.00	03.	401.48	34.75
520.00	0.32	106644.	-0.00	02.	354.70	34.14
540.00	0.28	105240.	-0.00	01.	318.55	33.72
556.17	0.26	104318.	-0.00	00.	295.36	33.39

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R-AERO-DD, Mr. Ryan
R-AERO-DA, Mr. Telfer
R-AERO-DA, Mr. Cremin
R-AERO-F, Mr. Lindberg (2)
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R-AERO-FF, Mr. Hagood
R-AERO-FF, Mr. Haussler
R-AERO-FF, Mr. Sheats
R-AERO-F, Mr. Stone
R-AERO-FM, Mr. Hardage (30)
R-AERO-FMT, Mr. Wittenstei
R-AERO-FF, Mr. McNiel
R-AERO-FMR, Mr. Solmon
R-AERO-FT, Mr. Benson (2)
R-AERO-P, Mr. Jackson (2)
R-AERO-P, Mr. Thionnet
R-SE-DIR, Mr. Ledford
R-AERO-AU, Mr. Reed
R-AERO-Y, Mr. Vaughan
R-AERO-P, Northrop
R-AERO-X, Mr. Thomae
R-AERO-AT, Mr. Wilson
R-AERO-FP, (CCSD), Mr. Fletcher
R-TO-DIR, Mr. May
R-TO-D, Mr. Wegrich
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